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VOL. XII.
No. 3.

MARCH, 1921

$4.00 a year.
60c. per copy.

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Published Monthly Except June to August by
WARWICK and YORK, Inc., Baltimore, Md.

Entered at the Baltimore, (Md.) Postoffice as second-class mail, January 24, 1921.

The Journal of Educational Psychology

is published monthly, except June, July and August, by Warwick & York, Inc., 10 E. Center street, Baltimore, Md. The issues of 1921 make Volume XII.

Manuscripts for publication, books or other materials for review and news items should be addressed to Harold Ordway Rugg, Chairman of the Editorial Board, 59 Edgecliff Terrace, Yonkers, N. Y.

The price of the Journal is $4 a year in advance. Foreign postage is 30 cents extra. Single issues are 60 cents each, and less than a full year's subscription is charged at single-issue rate.

Subscribers should notify publishers of changes in address at least four weeks before publication of the issue with which change takes effect.

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Warwick & York, Inc., Baltimore, Md.

THE JOURNAL OF
EDUCATIONAL PSYCHOLOGY

Vol. XII MARCH, 1921 No. 3

INTELLIGENCE AND ITS MEASUREMENT: A SYMPOSIUM

Editorial introduction: Probably the most striking advance of our generation in the practical application of psychological technic to educational and social affairs is the movement for the definition and measurement of intelligence. Especially impressive is the widespread effort now devoted to the construction and use of individual and group tests. It appears that this is an opportunity for this journal to serve as an effective clearing house for mature opinion on a most important problem. Accordingly, we have asked 17 leading investigators to contribute to a symposium on the following topics:

"(1) What I conceive 'intelligence' to be, and by what means it can best be measured by group tests. (For example, should the material call into play analytical and higher thought processes? Or, should it deal equally or more considerably with simple, associative, and perceptual processes, etc.?

"(2) What are the most crucial 'next steps' in research?"

Those invited to take part were: Doctors Bell, Buckingham, Colvin, Dearborn, Freeman, Haggerty, Henmon, Peterson, Pintner, Pressey, Ruml, Terman, Thorndike, Thurstone, Whipple, Woodrow, Yerkes.

Of these, all but three have signified their desire to contribute material. We print in this issue statements by Drs. Thorndike, Terman, Freeman, Colvin, Pintner, Ruml, and Pressey. Contributions from the other workers will be published in the April issue.

The editors hope that a vigorous discussion will grow out of these initial statements and will present further phases of the matter in subsequent issues of the Journal.

I. By E. L. Thorndike,
Teachers College, Columbia University.

1. The nature and measurement of intelligence. If we inventory the behavior of men and try to divide it up according as intellect, character, skill, taste or temperament is primarily involved, we shall agree fairly well in, say, ninety per cent of the cases. If, however, we try to make the division absolute we may agree very seldom. It is probably unwise to spend much time in attempts to separate off sharply certain qualities of man, as his intelligence, from such emotional and vocational qualities as his interest in mental activity, carefulness, determination to respond effectively, persistence in his efforts to do so; or from his amount of knowledge; or from his moral or esthetic tastes. Even so apparently remote a trait as muscular strength may in some cases cooperate almost indistinguishably in the production of what we would all call intellectual products. Thus a great scholar's achievement may be in part due to eye muscles which help make reading a pastime.

Taking these cases of behavior which are generally accepted as matters of intellect and trying to place each as primarily a matter of response to situations directly sensed, or as primarily a matter of planning, we shall again agree fairly well. So also if we rate them as primarily responses to concrete particulars or primarily responses to abstract qualities and relations. It would however be difficult and probably unwise to try to separate off *sharply* the responses concerned with directly sensed situations from responses concerned with planning; or those concerned with concrete features of things and men from those concerned with ideas and symbols. Hoeing corn and shooting a rabbit are easily distinguished from studying botany and ballistics, but behavior shows all sorts of intermediate forms.

Realizing that definitions and distinctions are pragmatic, we may then define intellect in general as *the power of good responses from the point of view of truth or fact,* and may separate it according as the situation is taken in gross or abstractly and also according as it is experienced directly or thought of. The power of good responses to abstract qualities and relations rather than gross total facts and to ideas rather than direct experiences may be called the more intellectual variety of intellect.

Either variety is, as human beings now are, specialized further according to the data operated on in the response and according to the form of the operation. The goodness of the response in any individual varies according to the particular task. The child who is the best of a thousand of his age at the undoubtedly intellectual task of mental multiplication of two-place numbers will not be the best at the equally indubitably intellectual task of thinking out verbal puzzles. As we change the task from space relations to animals, to plants, to machines, to moral issues, to numbers, the correlation never holds up to 1.00. As we change from accuracy in perception, to accuracy in memory, to accuracy in inference, all with the same data, the correlation again fails to hold at 1.00.

A part of this break to below perfect correlation is presumably due to circumstances of life and training which have given unlike amounts of emphasis to different data and to different forms of operation in the case of each of the thousand. But if a thousand were taken who had had identical training, it seems certain that the specialization of intelligence would still be found, the correlations still failing to be unanimously 1.00.

In measuring a person's general status in intelligence and in inferring therefrom what his rank in native intellectual capacity in general is, what we do is to test him with a fair sampling of data and operations. If his opportunities of training in respect to these have been inferior or superior to the group with whom he is to be compared we make the necessary allowance. This sampling should be wide enough and its various components should be easily enough weighted, so that the resulting judgment should be about his *general* status and *general* capacity—if we are to claim that it is general.

Some of us have, I fear, claimed a generality for our measures of status and a surety of inference from them to original inborn capacity which it would be very hard to justify. The estimates which the psychologist makes with his tests are much better than those which parents or teachers or ordinary medical practitioners make of the same facts, so that we are justly proud of them, but we should be the first to recognize their limitations. The value of a test score is its value in prophesying how well a person will do in other intellectual tasks. Our claims may wisely be limited to the actual demonstrated power of prophecy. For example, consider a score attained by a 12-year-old boy in say a combination of Stanford Binet, National A and

B and Haggerty Delta 2 (two trials of each). If the boy has had ordinary American opportunities, this score will prophesy rather accurately how well he will respond to intellectual demands in the cases of "book-learning" at the time and for some years thereafter, and very possibly for all his life. It will prophesy less accurately how well he will respond in thinking about a machine that he tends, crops that he grows, merchandise that he buys and sells and other concrete realities that he encounters in the laboratory, field, shop and office. It may prophesy still less accurately how well he will succeed in thinking about people and their passions and in responding to these. We know that, taking people as we find them, the ability measured by verbal tests is not the same as the ability measured by non-verbal tests; and there is reason to expect other similar specializations.

The intercorrelations of these various "intelligences" are, of course, high enough to make a measure of any one of them a better index of any other than the average parental hope or teacher's opinion is likely to be. If our 12-year-old boy is at the five-percentile station in our tests it will rarely happen that he will rank above average intelligence over any large area of mental activity; save by the drive of a great interest and the expense of much time upon the activity in question. On the other hand to assume that we have measured some general power which resides in him and determines his ability in every variety of intellectual task in its entirety is to fly directly in the face of all that is known about the organization of intellect.

The relative weight to be attached to analytical and selective and to perceptual and simple associative processes can only be decided by the correlations and partial correlations of these with the criterion which the test score is to prophesy, or some experimental facts giving equivalent information, considered with due reference to the time-cost of making the prophecy. In general, tasks which require efficiency in analyzing a situation into elements, selecting and weighting elements to fit a problem and organization or thinking many things together seem to give much better results per dollar or hour of cost. They perhaps include and sum up the action of many simpler associative processes. But a straightforward information test is also a valuable element. If time-cost is disregarded, a sampling of every kind of intellectual operation, and with every kind

of *datum,* will, if properly weighted, improve the prophecy of *general* intelligence. Unless it is properly weighted, however, it may injure it.

2. *Next steps in research.* Having used up my allotment of space in the previous discussion, I can only note that more research into every feature of intelligence and its measurement is needed, especially researches on the intercorrelations "total" and "partial" of the various forms of intellectual work of the world; on the intercorrelations "total" and "partial" of the abilities used and usable in our tests; on the permanence of our IQ's and EQ's; and on the "total" and "partial" correlations of each test at each age with itself at later ages and with each feature of the intellectual work of the world. The form of distribution of intelligence in the general adult population is also a matter of great practical moment. In relation to educational and industrial uses the problem of the effect of 'coaching,' special and general, is fundamental.

II. By L. M. Terman,
Leland Stanford University.

1. *The nature and measurement of intelligence.* Meumann has pointed out that the fault of Stern's teleological definition of intelligence as "general adaptability to the new problems and conditions of life," lies in the fact that it furnishes no clue for judging the value of different kinds of adaptation. Meumann would reverse Stern's procedure by first finding out what is demanded of intelligence and then analyzing the mental functions which meet that demand. In my opinion this is the only method of approach which will bring us any nearer to a psychological solution of the intelligence problem.

If we accept this view it is evident that the important intellectual differences among men will not be found on the sensory, perceptual, or purely reproductive level. It is well known that a moron may be able to see, hear, taste or smell, react to a signal, balance a bicycle, steer an automobile, or cancel A's about as well as an intellectual genius. The latter would be somewhat his superior in memory for non-sense syllables, would excel him still more in logical memory, and would outclass him hopelessly in the ability to distil meanings

from the raw products of sensation and memory. The essential difference, therefore, is in the capacity to form concepts to relate in diverse ways, and to grasp their significance. *An individual is intelligent in proportion as he is able to carry on abstract thinking.*

One may, of course, question our grounds for designating any kind of mental activity as "higher" or "lower" than another. Why, it may be asked, should certain types of mental processes be singled out for special worship? In fact, it is frequently intimated that the individual who flounders in abstractions but is able to handle tools skillfully, or play a good game of baseball, is not to be considered necessarily as *less* intelligent than the individual who can solve mathematical equations, acquire a huge vocabulary, or write poetry. The implication is that the two individuals differ merely in having different *kinds* of intelligence, neither of which is higher or better than the other.

It is difficult to argue with anyone whose sense of psychological values is disturbed to this extent. Such an individualistic view is not disposed of by calling attention to the obvious fact that civilization, with its science, art, government, religion, philosophy, and systems of credit, is unthinkable except as a product of concept elaboration and symbolic thinking; our opponent can retort that it is only our intellectual snobbery which leads us to regard the state of so-called civilization as "higher" than that of primitive man!

It can not be disputed, however, that in the long run it is the races which excel in abstract thinking that eat while others starve, survive epidemics, master new continents, conquer time and space, and substitute religion for magic, science for taboos and justice for revenge. The races which excel in conceptual thinking could, if they wished, quickly exterminate or enslave all the races notably their inferiors in this respect. Any given society is ruled, led, or at least molded by the five or ten per cent of its members whose behavior is governed by ideas. The typical pick-and-shovel man does his thinking chiefly on the sensori-motor and perceptual levels. Add a little more ability to think on the representative level and he may be able to repair your automobile, build you a house according to an archi tect's specifications, or nurse you in illness. Add a large measure of ability to associate abstract ideas into complex systems and he can design a new type of engine, draft the plans for a skyscraper, or discover a curative serum.

What I have said may seem like an over-elaboration of the obvious. Such a discussion ought, indeed, to be unnecessary. Unfortunately it is not. Many criticisms of the current methods of testing intelligence rest plainly on a psychology which fails to distinguish the levels of intellectual functioning or to assign to conceptual thinking the place that belongs to it in the hierarchy of intelligences. If an intelligence test can be shown to depend upon the language factor (i. e., upon the ability to think in terms of symbols), this is sufficient in the eyes of some psychologists to condemn it as non-valid. The subject who can not acquire a normal vocabulary, see the point of a fable, or be taught to read a paragraph with understanding is considered to have demonstrated his intelligence if he can trace a simple maze or assemble the fragments of a formboard. In fact the "idea thinker" is sometimes spoken of disparagingly or even a little contemptuously, particularly in the case of a child whose superior ability in this respect places him in conspicuous contrast with other children of the same age.

But if intelligence is the ability to think in terms of abstract ideas, we should expect the most successful intelligence tests to be just those which involve the use of language or other symbols. We should also be justified in demanding that an intelligence test should correlate well with what we may call "school educability." As a matter of fact it is precisely tests of this type which are surviving in the struggle for existence: tests involving arithmetical reasoning, language completion, naming opposites, matching proverbs, completing analogies, understanding difficult passages, etc. The list could of course be greatly extended, but all tests which are notably successful in measuring intellectual differences among adults have something in common with those named, even when they work with concrete materials instead of with words.[1]

With this conception of intelligence we can understand why it is so difficult to devise tests of the non-verbal or "performance" type which will bring out intellectual differences much above the level of the average child of ten or a dozen years. That it *is* difficult must be admitted by anyone who has attempted it and checked up his results. Non-verbal tests of the type used in the army Beta and performance examinations have of course proved useful on the intermediate levels of mental ability. However, even for children of

[1]It is not implied, of course, that an ideal intelligence scale would necessarily be composed entirely of verbal tests.

eight or ten years, no purely non-verbal battery of tests yet devised is as successful as any one of several existing batteries which make some demands upon the language factor. Tests for very young children must of course be still simpler and work largely on the perceptual or at best on the lower representative and reproductive level. With very young infants, intelligence tests, as such, are of course not applicable. The best we can do here is to determine the presence of a nervous organization which will later make intelligence possible (e. g., tests of ability to acquire conditioned reflexes).

That is, there is no type of test which will measure intelligence equally well at all levels. It is largely due to Binet's recognition of this fact that his intelligence scale has proved so successful. Instead of trying to measure supposed linear faculties, or "functions," Binet undertook to determine levels of mental activity. (The reader may have observed that the "faculty" devils so ruthlessly cast out of the psychological temple by Herbart and James are wont still to parade among us under the alias of "mental functions.") He recognized that with increasing maturity intelligence becomes something different. Ruml's recent criticism of current test methods on the ground that these methods are usually based on the assumption that general intelligence can be expressed as a linear or one-dimensional function, was antedated some fifteen years by the following statement of Binet: "This scale (Binet's 1905 series of tests), properly speaking, does not permit the *measurement* (italics added) of intelligence, because intellectual qualities . . . . . can not be measured as linear surfaces are measured, but are, on the contrary, a classification, a hierarchy among diverse intelligences."[1] While all will admit that in occasional overdrawn statements Binet sometimes carries his theory of levels too far, I do not know of any other psychologist who has brought such penetrating insight and such power of psychological analysis to bear on the intelligence problem.

It is clear why no intelligence scale made up of a battery of serial tests, each intended to give a linear measure of some supposed mental "function," has ever worked successfully over a very wide range. Even in the relatively narrow range in which it operates, such a test does not, at all points, bring the same kind of mental activities into

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[1]In the above reference to Dr. Ruml's criticism of mental test methods the writer does not wish it to be understood that he agrees with the general spirit of the article in question or with all of its criticisms, some of which he believes to be ill-founded and unjust.

play. Success in the easier part of the test may depend chiefly on the subject's ability to remember what he is told to do; see likeness and differences on the representative level, or even to a considerable extent on eye-hand coordination in the use of a pencil. In its more difficult parts the same test may have to do with the most subtle types of relationship among highly abstract ideas. How naïve to suppose that each test of such a battery measures a particular function! How absurd, also, to regard intelligence of every kind as of equal rank with intelligence of every other kind!

In closing I should like to point out two pitfalls which ought to be avoided in our thinking about the nature of intelligence. They are opposing dangers, and if we are overcautious in avoiding the rock of Scylla we are so much the more likely to be drawn into the whirlpool of Charybdis. (1) We must guard against defining intelligence solely in terms of ability to pass the tests of a given intelligence scale. It should go without saying that no existing scale is capable of adequately measuring the ability to deal with all possible kinds of material on all intelligence levels. Accordingly, the validity of a new test should not be judged entirely by its correlation with existing tests, however good these may be. There must be continued search for useful outside criteria. (2) On the other hand, in our anxiety to escape the evils of a closed system we must guard against indiscriminate and ill-considered use of outside criteria. To condemn an intelligence test because it yields low correlations with success as a mill hand or street car motorman is an example of this error. Another mistake that results from over-evaluation of a single criterion is seen in the effort to embody in a given intelligence scale *every* kind of test which will add to its correlation with the criterion in question. This mistake is especially likely to occur if one is interested in the predictive uses of the test. The effect of this error may be to pervert grossly the test as a measure of intelligence. If we wished to devise a test which would give the most accurate possible prediction of the class marks a given group of college students would receive, we ought to include in it measures of personal beauty, voice quality, bashfulness, willingness to cultivate the good graces of the instructor, etc. All of these qualities undeniably influence a student's marks, but they do not belong in a battery of tests designed to measure intelligence. It should not be the aim of an intelligence test to give us the *best possible* prediction of events of this kind.

Let us use outside criteria, by all means, but let us use them with psychological discrimination.

2. *Next steps in research.* I would list the following as a few of the many important "next steps" in intelligence testing. No significance is to be attached to the order of mention.

1. Systematic exploration for valid tests of particular aptitudes, including abilities especially concerned with success in typical kinds of vocational employment and in several of the main types of academic and professional careers. Manipulative-mechanical ability, mathematical ability, scientific ability, leadership ability, and ability in drawing, painting and sculpture are illustrations.

2. A more serious effort should be made to devise non-verbal tests capable of bringing out differences in general intelligence on the higher levels. The need for such scales both for individual and group examining is very urgent. If serial tests were used it would probably take about three such scales to cover the range from five-year ability to the higher adult levels.

3. The time is ripe for the development of an "infant" scale for measuring intelligence on the levels below three years. More reliable methods of diagnosis at this period would save a certain proportion of individuals from mental deficiency.

4. The Binet scale needs to be thoroughly overhauled in the light of recent progress in test methods. The scale should be made over in at least two or three forms, interchangeable and non-duplicative. Each should require not more than thirty to sixty minutes for its administration and should be considerably more accurate as well as more convenient to give and score than the present Stanford Revision. The writer has already undertaken this task, which will of course require several years for its completion.

5. Investigations are needed, of a more intensive kind than have yet been made, of a large number of individual tests for the purpose of determining their best possible composition and form, the best procedure for giving and scoring them, and their exact relationships to a variety of other tests. Any one of at least forty or fifty tests which might be named would each amply justify two or three years' work of a competent graduate student.

6. Next steps in the application of intelligence tests to scientific and practical problems include investigations of race differences, mental inheritance, the psychology of genius, normal and abnormal

mental growth, environmental influences, mental fatigue, and the relation of general intelligence to moral traits, social adaptability, and success in school and the vocations.

7. Investigation of instinctive, emotional, and volitional traits and of the combinations of these which are involved in pre-psychopathic conditions and normal variations in temperament. As this type of investigation is largely outside the scope of the intelligence problem its importance need not be dwelt upon here.

8. Early accomplishment of certain of these next steps is contingent upon finding money to finance more extensive investigations than we have yet become accustomed to. Thoroughgoing work in this field is extremely costly. My experience in helping to spend $25,000 in the manufacture of one intelligence scale has convinced me that nothing less than $100,000 is really adequate for such a task. The sum of $1,000,000 is needed for a ten-year program of systematic, organized research looking toward the manufacture and standardization of eight or ten scales for measuring general mental ability. As much more is needed for research in the measurement of special aptitudes.

III. By F. N. Freeman,
University of Chicago.

1. The nature and measurement of intelligence. I conceive intelligence to be a somewhat more inclusive capacity than is implied when it is used as a name for our present tests. For this reason, it seems to me that it would be better to use a term of somewhat narrower connotation to designate these tests. The mental capacity designated by the term intelligence seems to me to include, besides the elements which are usually measured by our tests, certain other types of capacity which they measure scarcely at all.

The capacities measured by our tests may be described from the structural point of view as involving chiefly: sensory capacity; capacity for perceptual recognition; quickness, range or flexibility of association; facility in imagination; span or steadiness of attention; quickness or alertness in response. Excellence in capacities of this sort is well designated by the term brightness. We recognize, however, that a person's achievement, or even his intellectual capac-

ity, does not seem to correspond perfectly with his capacity in any of these various specific traits or with all of them put together. We sometimes say that a person is very bright but not very intelligent. We mean that he does not use his mental powers in such a way as to be most productive. The characteristic which I am referring to is sometimes called temperament or moral character, but it seems to me it can be shown that there are certain intellectual traits which are left out of our present scheme of tests and which should be included in a total conception of intelligence.

These additional characteristics may be described as: mental balance; co-ordination of the mental processes; the judicious management of the processes of learning or reflection; mental control; mental adjustment; the direction of the attention toward the significant aspects of experience; a due degree of non-suggestibility; the adoption of intellectual purposes and the adaptation of means to their satisfaction; sensitiveness to significant combinations between experiences which illuminate one another or which are effective in building up systems of thought; balanced and sane reaction to the entire world of things, ideas and persons.

2. *Next steps in research.* The attempt to catalogue some of the characteristics which would ordinarily be recognized as belonging to high intelligence indicates, it seems to me, that our tests are much too fragmentary to be thought of as even approximately complete measures of intelligence as a whole. There is undoubtedly a correlation between brightness and these broader aspects of intelligence, but we ought to devise tests to measure such processes as these more directly than is done by our present tests. This is one of the "next steps."

The second step is to devise tests of more specific capacities. The present-day general tests arose from the discovery that better correlation could be obtained between tests and other measures of undifferentiated ability, such as school marks and judgments, than could be obtained with simpler tests. A group of tests, each one of which has a low correlation with school marks, will give a considerably higher correlation when their scores are combined. There are various theories to explain this fact. It is not entirely clear whether such a combined score gives merely the composite result of a number of different abilities, or whether it is the measure of a central ability which is common to the various particular reactions and emerges

as the common factor. Whatever may be the cause, the practical bearing of the discovery is clear.

While these composite tests are of more practical value than those which give no correlation whatever with measures of every day achievement, they are far from satisfying our practical demands. Whether the pupil's intellectual capacity is a combination of general ability and of unrelated specialized abilities, or a combination of various abilities which are related to one another in varying degrees, the practical treatment of the individual requires that we should be able to measure his relative ability in more or less specialized types of activity.

This demand for tests of more particular capacities may appear reactionary to one who is acquainted with the history of mental tests. It was with this aim that the earlier tests were designed, and in seeking which they failed. It is obvious therefore that our procedure must differ from the early procedure if we are to succeed. There are two ways in which we may conceivably improve upon the early efforts. In the first place, we may utilize the improved technique with which the material is selected and organized, with which the test is presented to the child, the responses scored, and norms established.

There is another respect, however, in which it is necessary to improve upon the earlier attempts to test specific capacities. This consists in a different and improved definition of the components of ability. The facts of correlation present many puzzles from the point of view of our ordinary classification of mental abilities. It is common to find, for example, that abilities which are ordinarily classed under separate heads, according to our usual psychological system, correlate more closely with one another than do abilities which fall within the same field. One explanation which is offered for this fact is that the abilities which correlate with one another possess the hypothetical common factor in high degree. Another possible explanation is that there are mental traits or abilities which run across our ordinary classification. If we could discover what these abilities are, we might be able to determine and measure groups of abilities which correlate closely with one another but not so closely with other groups. I am inclined to think that there is one example in which we would find that our new classification of abilities would agree with our customary psychological system. This example is

memory. It is of course quite probable, and in fact almost certain, that an individual's memory for various types of experience differs considerably. On the other hand, it seems to me to be a hypothesis worthy of investigation that the memory or retention of experience is a characteristic of an individual's mental life which is rather distinctive and which is a more or less constant factor in his various mental processes. At any rate, no systematic experiment has been made to determine whether this is true.

Two important "next steps" appear to me, therefore, to be to measure broader aspects of intelligence, and to devise specific measures of significant components of ability.

IV. By S. S. Colvin,

Brown University.

1. Nature and measurement of general intelligence. General intelligence has been defined as "general mental adaptability to new problems and conditions of life." To my mind this definition is somewhat too narrow. In a very true sense intelligence is mental adaptability to environment. This conception, however, is in one respect too broad since it includes instinctive adaptations as well as those that have been acquired through experience. Of course, psychologists sometimes speak of the psychic life of micro-organisms and frequently use the term intelligence in connection with instinctive acts of such animals as ants, bees and wasps, whose adaptations to environment seem to be almost entirely on the plane of instinct. On the whole, I consider the most helpful viewpoint from which to consider intelligence is that it is equivalent to the capacity to learn. *An individual possesses intelligence in so far as he has learned, or can learn to adjust himself to his environment.* In a sense this conception is substantially the same as that quoted in the definition first given. However, it does not unduly emphasize the problem aspect of intelligence and rightfully attributes intelligence to those animals whose sole ability to learn is confined to the hit-and-miss try-out of experience ("trial and error").

Psychologists have accepted this definition practically if not theoretically. An inspection of intelligence examinations clearly shows

that those who framed them have not confined their tests to problem solving, even in its rudimentary forms. These tests measure an individual's intelligence largely in terms of what he has learned, thus obtaining indirectly a measure of his learning ability. Vocabulary tests, range of information tests, "same and opposites" tests, tests of fundamental operations in arithmetic, and the like, call for little ingenuity. If the individual has the requisite skill and knowledge he can satisfactorily perform these tests. They are appropriate tests for intelligence only on the theory that they test ability to learn by discovering what has already been learned. Even those tests that demand verbal and mechanical ingenuity are valid only in so far as individuals taking these tests have had common opportunities to learn the elements necessary in solving the problems involved in sentence completion, thought interpretation and the like. It must be remembered that even the ability to think in a sustained and logical manner is based on having learned how to think. Thought is a habit and is acquired through learning. In a word, the validity of all mental testing rests on the fundamental assumption that those tested have had a common opportunity to learn the skills, facts, principles and methods of procedure exemplified in the tests. It follows for this reason that many of the standard school tests now in use are reasonably good measures not only of specific aspects of acquired intelligence, but also of general (innate) intelligence. All the individuals in the school group tested have had the same training, or at least very similar training. Some have learned more, others, less; those who have learned less possess less learning capacity,—hence less general intelligence.

Since, however, general intelligence cannot be considered as a single unitary factor (according to the Spearman-Hart-Burt hypothesis), but as a common average of many different factors positively, but by no means perfectly correlated, intelligence tests should explore as many aspects of human ability as possible. This is important for prognostic purposes. It is even more important if intelligence tests are to be employed to diagnose varieties of mental abilities. The investigator frequently finds individuals who do well in certain kinds of mental tests and who do poorly in others, not because of difference in opportunity, experience or interest but because of difference in native ability. We need the simpler tests, tests involving specific knowledge of facts, memory, perception and the like,

but we need also, and in a greater degree, tests to measure the higher intellectual processes,—tests that will give the individual who thinks carefully, accurately, but sometimes ponderously, an opportunity to show his ability. Doubtless speed of learning and efficiency of learning are positively, but by no means perfectly, correlated.

2. *Next steps in research.* As I have already pointed out in the previous discussion, we need at present test elements that emphasize, more than any now existing do, deliberation and substained rational ability,—tests in which speed is relatively unimportant and in which analysis, synthesis and an extensive attention-span are the chief factors of importance. Pioneer work in this field, as indeed in many others, has already been done by Thorndike, particularly in his tests for college freshmen.

In one sense of the word there are too many mental tests at present. This plethora is doubtless valuable and necessary, as far as theory of mental testing is concerned, but it has definite practical drawbacks. The tests now "on the market" (and doubtless their commercial value has had something to do with their recent rapid development), while in general valuable, have too many features in common and are too nearly of equal value for practical purposes to make them all necessary. I hope the time will soon come when a committee of skilled psychologists will select the elements most valuable in the tests now existing, add others that are lacking, and after carefully standardizing this complete test, will issue it as the one recommended for general use in the grades and for the ages for which it has been devised. Of course, there would still be several tests,—one for the primary grades, another for the intermediate and grammar grades, one for the high school and one for the college,—but there would not be a multiplicity of tests for each level of school development, and there would be definite norms established for the guidance of teachers. At present either norms are lacking or they have been imperfectly and inadequately devised. And, by the way, would it not be well in arriving at standards to check back the results of the tests on groups of known intelligence and ability?

A further step that is necessary from the standpoint of the practical value of mental tests is that teachers and administrators should be more carefully informed as to the value and limitations of the results of intelligence testing in solving problems of instruction and supervision. Frequently tests are given and the results are in no

way utilized. Often tests are given and the results are wrongly interpreted and applied.

The most important "next step" for purposes both of prognosis and diagnosis is the formulation of a test that will inform us of the character qualities of those tested. It is true that there is a positive correlation between the results of intelligence tests and character, partly because intelligence and character are related and partly because our so-called intelligence tests are to an extent character tests as well. However, there are many instances in which intelligence tests fail to be of value practically because they give only slight indication of those qualities of character and temperament that are vital in all human achievement. In my work with students at Brown University, I have found scores of instances in which intelligence tests have not only failed to indicate in a positive way college performance, but have also shown results at variance with this performance. In a considerable number of instances the lack of relation has been clearly due to the fact that qualities other than intelligence have played a deciding role. The psychologist who devises a character test that has a reasonably high validity will earn for himself a position in the field of ability testing equal to that of Binet,—yes, even higher, for his problem is more complicated and his task more difficult. However, until such character tests are available we shall have solved only one-half of our problem in the prognosis and diagnosis of those elements which lie at the basis of human achievement.

V. By Rudolf Pintner,

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1. Nature and measurement of intelligence. I have always thought of intelligence as the ability of the individual to adapt himself adequately to relatively new situations in life. It seems to include the capacity for getting along well in all sorts of situations. This implies ease and rapidity in making adjustments and, hence, ease in breaking old habits and in forming new ones. Fundamentally, this leads us back to the general modifiability of the nervous system. An organism whose nervous system is very modifi-

able can adjust itself quickly to new types of situations and in this way react with more intelligence to a greater number of situations.

The reactions to which we apply the terms "intelligent" or "unintelligent" are differentiated from those to which we apply the term "emotional," although any sharp division between these two types can hardly be made. Nevertheless, the distinction is a practical one which it is useful to retain.

Binet laid the emphasis upon judgment and reasoning, and in doing so turned the trend of investigation from the simpler to the more complex mental processes. Before the work of Binet, psychologists had been mainly concerned with the measurement of the simpler processes, and their work had not resulted in anything very practical from the standpoint of the clinical psychologist or educator. It was primarily the work of Binet that stimulated the use of tests of the more complex mental prosesses and led us to the combination of complex tests with which we are familiar today.

In no field of investigation is dogmatic assertion to be tolerated and certainly not in this new and vaguely defined field of mental testing. Unquestionably mental tests calling into play the synthetical and analytical activities of the mind, reasoning, judgment and the like, have up to the present time been most useful for practical measurement purposes. They seem to reproduce the complex type of situations common in modern civilization. We dare not, however, dogmatically assert that these tests are the only ones that ever will yield satisfactory measures. It may be that the simpler and more elementary processes, upon which the more complex depend, might prove useful for the measurement of intelligence. Up to the present time no one has been able satisfactorily to use them, but there would appear to be room for further research in that direction, even though the field at present seems rather barren.

Because we are dealing with something which we hardly know how to define, because we are groping for means to measure reactions to extremely complex and different situations, we must be very careful not to limit in any way the type of material we use. Intelligence is shown in dealing with things as well as with words, in dealing with living men and women as well as with symbols, in handling a paint brush or chisel as well as a pencil, in carving stone or laying brick as well as in making verbal responses. We, therefore, need intelligence tests of all types. And by intelligence tests I mean tests of

the general ability to do all sorts of things as opposed to educational and trade tests which are specifically made to measure the knowledge which an individual has been directly taught. If we believe in this large view of intelligence, we are painfully aware of the paucity of tests that exist at the present time. I cannot believe that we have exhausted our ingenuity in the construction of different types of tests and I hope to see many new types of tests constructed in the future. All sorts of tests and various combinations of all sorts of tests are needed.

As a matter of fact when we are confronted with the practical situation of planning a school survey, there are not many tests from which to choose. There are very suitable tests for the first and second grades. There are a few more available for the other grades. There are all too few really adequate tests for the high school and most of them are surprisingly alike. Really good discriminative scales for college students are rare. When in addition we look for scales with adequate standardization we still further decrease our list. So there is plenty of room yet for tests, for different kinds of tests and for well constructed and standardized tests.

Occasionally we hear the cry raised that of the making of new tests there is no end and that what we need most now is to refine our instruments of measurement, equate them, and standardize them. To refine, equate, and standardize would be good, but merely to do that would mean stagnation. The perfect measuring instrument of intelligence is not yet at hand and we need all the attempts, however crude and bungling some may be, in order to help achieve our aim.

Most of us can remember the horror of the "pure" psychologists at the advent of the Binet-Simon Scale and the horror grew into dismay as, in the course of time, article upon article poured from the press and threatened to turn all psychological periodicals into Binet journals. We were counselled and advised with, we were told to stop, we were told to go back to essentials and first principles and what not. Even some of the Binet workers themselves were dismayed and tried to stop the flood and advised staying where we were, until we had refined and analyzed the Binet monster. It is good that we did not, even although we might have had a refined Binet scale better than the best we have at present. In the meantime, however, the flood rolled on and brought in group tests of all kinds and the wider outlook on mental testing which we have achieved at

the present time. And it is to be hoped that mental testing will go on expanding and broadening in the future.

2. *Next steps in research.* I have already indicated in the previous paragraph one of the next steps in mental testing, namely the construction of various types of tests for the measurement of the various aspects of intelligence. We must not allow ourselves to imagine that the type of group test most common at the present time is the only measure of general intelligence.

Another profitable line of work is to make the tests function in the school and in life in general. If we have obtained some reasonable measure of intelligence, the value of this is very significant, and I do not believe we have really begun to appreciate the uses to which it can be put. A combined use of various mental and educational tests, suggested by several workers, is opening up profitable lines of research both theoretical and practical. The systematic use of these different measures must lead us to raise important educational questions. The amount of educational attainment to be expected of any specific degree of intellectual ability can be stated in more definite terms than we have been able to state it before. The practical bearing of this upon the efficiency of the school must be carefully studied. Annual or semi-annual surveys of schools should be systematically undertaken. Various methods for the elimination of wasted intelligence should be introduced as a result of the findings of the surveys, and the value of each such method should be studied. Our question would be: To what extent does this or that method actually decrease the amount of wastage? In other words, I feel that the time has now come for systematic measurement of the same group of children over several years, by means of both educational and mental tests, and combinations of these; and along with this a study of educational devices for increasing efficiency.

So far I have been discussing mental tests in the narrowest sense of that term. I feel, however, that the time is now ripe for active investigation of the emotions, the character, the will and so forth, by means of mental test methods. A beginning in this work has already been made by a few workers. It is to be hoped that work in this field will increase rapidly, so that we may learn what possibilities exist for objective measurement of these aspects of the individual. Personally, I feel that the possibilities are great, and that in the near future we may arrive at some quantitative expression of

the emotional side of the individual. This will bring us one step nearer to our ideal, namely, a psychological profile or equation of the whole man.

VI. By B. Ruml,
Carnegie Corporation, New York City.

1. Intelligence and its measurement. It seems to me that the question as to the nature of intelligence can hardly be debated at the present time. There are two reasons for this: first, the lack of precision in the terms and concepts that must form the basis for such a discussion and second, the absence of factual material on so many of the essential points. Much of the best data that is available is compromised by inadequate sampling and controls, and by contradictory reports from various observers. For example, the status of the "common factor", "general intelligence", is extremely unsatisfactory; and surely the general problem of intelligence requires for its solution an accurate statement concerning this alleged "common factor".

As to the best kinds of mental tests, I feel that test materials of every kind are still desirable in test research. We need data concerning the simpler mental processes as well as the higher. The one limitation that may properly be made is that in any test which yields a single quantitative result or score, the content should be as homogeneous as possible. Valuable as omnibus tests and mixed test series may be for practical purposes, it seems unlikely that these will assist in any really important way in the understanding of intelligence.

2. Next steps in research. The most promising "next steps" will perhaps come through the study of changes in test score and in inter-test correlations with change in chronological age.

For example, for certain tests there is reason to believe that in spite of considerable variability, there is practically no correlation with chronological age between the years of 9 and 13. How does this come about? Will it not be illuminating to know more completely than we do now what types of tests behave in this manner? It is, of course, clear that we are dealing with relationships that

show non-linear regressions, and the commoner statistical approach will probably be inadequate.

Again, there is some slight evidence that inter-test correlations are lower for children of a given age than for adults. We have little data of a quantitative kind to show how great this difference is, neither do we know how these relationships behave for various kinds of test material. But if with more factual material the reality of this difference in size of inter-test correlations is established, the attempts at explanation will be sure to develop interesting and important light on the general problem of intelligence. Research of this type requires very accurate sampling of subjects and is, of course, very difficult on a small scale.

A third attack of some promise is suggested by the "will-profile" technique of Dr. Downey. The methods used by Dr. Downey in constructing her test materials are rather different from the methods of building many intelligence tests. They suggest the need for a much more exact qualitative study of the test situation than is ordinarily made as a preliminary to final standardization in quantitative form.

Finally, there is need for more adequate methods of representing the results of test performances. The profile gives a good deal of information, but it is difficult to interpret, and is rarely used in providing data for generalization.

VII. By S. L. Pressey,

University of Indiana.

1. Intelligence and its measurement. The writer has been asked for a statement as to what he conceives intelligence to be, and as to what types of test materials can best be used for the measurement of intelligence. Frankly, he is not very much interested in the question—although a large part of his time goes to work with tests of "intelligence". Instead, he is interested to know what such tests will *do,* in solving this or that problem. Suppose, for instance, one is intending to survey a school system in order to find those children who should be put into special classes—classes for those so dull as to be incapable of profiting by the regular school work. Tests in the

school subjects cannot be used for this purpose, since some children would then test low because they had had their first training in poor country schools, or had been out of school because of poor health. Under these circumstances, one naturally makes up an examination not involving matters taught specifically in school, but a test as much like school work in other respects as possible. We have, then, a "general" test.[1]

After a number of such tests have been made up the next step is, naturally, to evaluate them according to the efficiency with which they deal with the practical problem for the solution of which they were made. The obvious procedure is to give the tests to (1) a group of children who are known, from long and intensive study of them, to belong in special classes, and (2) another group known to belong in the regular classes. The tests which separate these two groups most distinctly are, then, the tests to include in the final scale.

Measurement of capacity for school work by such a paraphrase of school work, but with the specific elements of schooling left out, is surely a very natural thing to do. It is also natural to attempt the selection of children at the other extreme—the exceptionally bright children, who are capable of more advanced work than they are now doing—by means of such tests. The capacity of these children for this advanced work cannot be determined by giving them some of this advanced work to do; the point of the whole situation is that opportunity has not been given to acquire the specific elements in this advanced work. In fact, *any* effort to get back of the school's actual disposition of its children, into classes and grades, naturally suggests the use of such paraphrase of school work, but with the specific elements eliminated. And the usefulness of different types of this material must be determined by actual trial with the concrete problem to be dealt with.

Well—and if such tests are of service in dealing with a variety of problems one may come to think of them as tests of a fundamental, unitary, general intelligence. An elaborate theory, with elaborate statistical expression, may then be developed. But the hypothetical nature of the concept must be kept in mind (and the educational situation which first gave rise to such tests, also). Particularly,

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[1]The problem described is, of course, the problem which Binet faced in 1905 and which gave rise to the original Binet Scale.

one must not permit himself to be hypnotized by the statisti[illegible]. Always, it must be kept in mind that there is no value in measuring intelligence simply for the sake of measuring it; the tests are given in an effort to deal with some practical problem. And it is in proportion as they deal efficiently with that problem that they are to be considered satisfactory.[2]

Frankly, then, the concept of general intelligence is for the writer, primarily, simply a working hypothesis which has been very helpful in the first attack upon problems of prognosis. It should continue as a working hypothesis until other hypotheses are found to work better. But investigators must not be so dominated by the concept of general intelligence that they fail seriously to consider other possibilities. Particularly to be avoided is the easy notion that a test of intelligence will solve all educational difficulties, that intelligence testing is the longed for short-cut method which will put everything in the schools finally and completely to rights. The theory is simply an assumption that prognosis problems can be generalized. It has been of great use in suggesting certain general lines of approach,—and in giving us courage to attack the otherwise impossibly complex prognosis problem. It will do equally great harm if it prevents analysis of the prognosis problem, now that methods are becoming sufficiently refined to make this possible. The safest, most empirical, and most practical method of making this analysis (to the writer's mind) is to study the relation of the tests to particular practical problems. From such study any general factors will, in time, emerge of themselves.

2. *Next steps in research.* Effort in two directions is especially needed; in neither case should the study deal with general intelligence:

(1) It should be obvious that even if certain abilities (as in arithmetic) were highly specific, this would never be discovered if scores on tests were always summed into a single rating in "general intelligence", marks always averaged, or teachers asked to estimate general ability. Of course, under such circumstances, there will appear

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[2]The most fundamental statistical problem of all must surely always be: "Are these methods applicable to the data and problem in hand?" Instead, there seems to be a tendency to regard a thing as so, if it can only be squeezed into a formula. And we find ourselves, before long, talking easily about absolute point scales, zero points in intelligence, and so on—as though we knew all about it. Such practice might, perhaps, be called "statistical transcendentalism."

[3]The writer has presented this point of view more fully in a recent paper, "Suggestions Looking Toward a Fundamental Revision of Current Statistical Procedure, as Applied to Tests." *Psychological Review.* Vol. 27, pp. 466-472. November, 1920.

to be a general factor, because everything has been generalized! Yet the results of such procedures are used over and over again as evidence of the all important character of innate, general ability. The situation verges on the absurd. There must, then, be intensive critical study as to the concept of general ability—and a more open mind on the subject than seems to be common at present.

(2) In the second place, there simply must be a courageous attack upon the problem of measurement of other than intellectual factors. It is becoming increasingly obvious that matters of temperament and character are of very great importance, that they operate quite largely independent of intelligence, that prognosis problems cannot be adequately understood without an evaluation of these factors. It is also probable that these factors are more educable (in the large meaning of that word) than intellectual traits. From every point of view, then, work in this field seems most desirable. Some beginnings have already been made. It is in this direction especially, the writer feels, that research effort should be directed for the next few years.

THE GROWTH OF INTELLIGENCE AND THE INTELLIGENCE QUOTIENT

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Though the measurement of intelligence has of late made notable advances in its practical applications, we are yet considerably in the dark when we ask detailed questions regarding the interpretation of our results, questions which are not mere academic puzzles but which have a number of important practical bearings. That this is the case is evident when we attempt to interpret in a comparative way the norms now available for the different kinds of mental tests. In a recent article in this journal[1] Freeman has attempted to call in question certain assumptions that seem necessary for the validity of the IQ as used in Binet testing. The assumption of "divergence of growth curves as well as a decrease in rate of growth," made by Woodrow in his *Brightness and Dullness in Children* respecting the development of intelligence is questioned; and, after pointing out that the yearly increments in certain of our group intelligence norms are about constant through a number of years, Freeman concludes as follows: "It appears from these facts that both the assumptions which may serve to explain the validity of the IQ in the case of the Binet Scale are in question." (P. 12.) The validity of the IQ for prediction depends, of course, on its constancy throughout a number of successive years; and since the IQ is a ratio of mental age to chronological age, it is obvious that the lines of intelligence growth of individuals of different IQ's must diverge, so that a retardation of one year at an early age will equal in effect one of two or more years in later stages of growth. Moreover, speaking in general of the rate of growth of intelligence, "It may be shown mathematically that if the rate of growth were the only factors determining the IQ, and if the IQ were valid, the curve would be logarithmic, the formula

[1]Freeman, F. N. The Interpretation and Application of the Intelligence Quotient. *J. Ed. Psychol.*, 1921, *12*, 3-13.

being $y = \log x$."[2] Freeman produces the curves of a number of point-scale norms to show that the logarithmic form of the growth of intelligence is not in evidence. Most of these curves are in fact nearly straight lines, some of them being exactly straight, through several years,—that for Yerkes' point-scale tests being straight from years 4 to 12; for Pressey's, from years 8 to 16, with a slight divergence covering years 11 to 14; and similarly for the Haggerty tests, the Pintner non-language tests, the National Intelligence Test, and others.

From these "curves" Freeman seems to read off directly the normal rate of the growth of intelligence; that is to say, he seems to regard these curves of norms for point-scale tests as intelligence-growth curves, in as much at least as these tests actually measure intelligence. While he admits that these curves offer certain difficulties—such as a gradual bend toward the X-axis in certain cases at about the beginning of adolescence, possibly due to the nature of the tests themselves, and also an occasional small break in the curve—and that the point of actual slowing up of growth in intelligence can be located only after more extensive investigation, he concludes that "The preponderance of evidence, however, seems to indicate that up to some age in early adolescence at least the rate of growth is approximately uniform." (P. 9.)

This is precisely the point, it seems to me, at which Freeman's whole position must itself be called seriously to question. His position seems to be founded on the view that these curves are in themselves intelligence-growth curves. Except on the most superficial view of them, one that unfortunately is too often taken, this position is wholly untenable. The curves, indeed, show only the *number of points scored* at the ages indicated under certain standard conditions, the most important of which is a definite limitation of time, constant for all ages.

In the first place, it is hardly justifiable to apply to the Binet scores from which the IQ is obtained, inferences of this nature from scores derived under this time-limitation. In the Binet tests there is practically no time limit in most cases, and the tests vary from age to age with considerable overlapping. This is, of course, why we

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[2]Freeman, *up, cit.*, p. 5. It is obvious, however, that the simple logarithmic curve does not hold strictly, especially at the extremes of age, for the growth curve of intelligence. There is some degree of intelligence, probably a comparatively large amount, in the year-old child, and there is also rather good evidence that its growth does not continue to senility, whatever we may conceive intelligence to be.

have had from these tests no very serious attempts to establish any well defined view regarding the exact nature of the increments of intelligence development through successive years, though the logarithmic curve has been implied as a rule as indicative of the rate of mental growth.

Secondly, and this is our most important point, making inferences as to the nature and rate of intelligence growth—either relatively to earlier periods or absolutely—from absolute scores of average accomplishment in definite periods of time, is a business that is beset with hazards for a young science, to say the least. A concrete illustration will tend to bring out the difficulty in question. The 1920 norms of the Otis Scale, Advanced Examination, are as follows:

TABLE I.

	Age.										
	8	9	10	11	12	13	14	15	16	17	18
Total time allowed.....	42	42	42	42	42	42	42	42	42	42	42
Standard score.....	40	52	64	76	88	100	112	121	125	128	130
Increase in score in one year...		12	12	12	12	12	12	9	4	3	2

It is obvious that the equation

$$W = ta \qquad (1)$$

will hold, if W represents the work done, while t and a represent, respectively, time, or number of minutes, and the average amount of work done per minute. Applying this equation to our special case, and letting W stand for the total number of points scored and a for the average number per minute, we may for the present purpose disregard any "work" that does not make toward the production of scores. We are compelled here, moreover, and in what follows, to assume that each score-point has equal value with every other score-point. Now figuring the values of a for the total scores given in Table I for years 8 to 14, through which the scores increase uniformly so far as the absolute units are concerned, we get the values for a indicated in Table II. It is to be noted that the time of 42

TABLE II.

	Age.						
	8	9	10	11	12	13	14
Value of a.....	.95	1.24	1.52	1.81	2.10	2.38	2.67

minutes for the Otis test is exclusive of time used for instructions and all preliminaries; it is the time actually devoted to the work of score-making.

Now it is obvious that a also makes a constant increase from year to year, the increment being about .286, whereas the increment in the total score is 12, as shown in the first table. Equation (1), when applied in the present case to the changes in ability through successive years, may be put into the form

$$W + nK = t\ (a + nk), \qquad (2)$$

in which n indicates the number of years after the eighth, and k and K represent, respectively, the constant yearly increments in average per minute and in total score. In these equations it is seen that a and t hold inverse relations, speaking roughly, and that therefore making t constant, as is done in the point-scale group tests, makes the average-per-minute values vary directly with the total score. Is any one going to maintain seriously that an increase from .95 of a score-point per minute, at eight years, to 1.24, at nine, (31%) is indicative of the same growth in intelligence that an increase from 2.38 to 2.67 score-points (12%) from year thirteen to year fourteen represents? The ratio of increase decreases perceptibly from year to year. Shall we base our view of mental growth on the absolute increments or on the proportionate decrements in time for doing a specified amount of work? Probably no one knows. One's choice will depend on just what one means by growth of intelligence from year to year and in what relationships one is considering such growth.

The importance of this point comes out clearly if we ask ourselves: How does the speed decrement, *in absolute units,* for doing a constant amount of work—making a given score-point—behave through successive years? From the data given in Table II, we can determine the average number of minutes per score-point for the successive ages there shown, or the values of t as given in equation (1) for successive years of mental growth, if W is made unity. Thus we find in Table III the number of minutes required by children of the successive ages shown, to make on the average a score of one point. Figure I shows both the absolute increments of a and the absolute decrements of t as given in the tables.

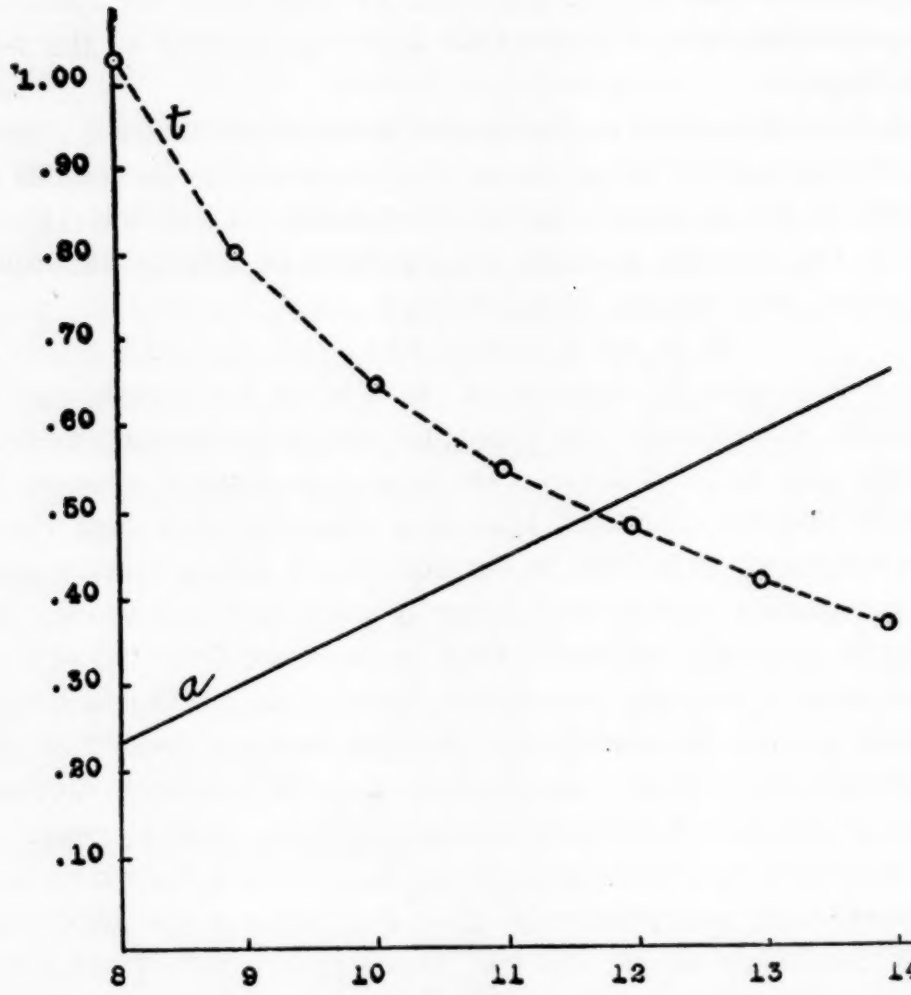

FIGURE 1.

The curves are norms of the Otis Scale, Advanced Examination. Curve *a* shows the average number of score points made per minute, while curve *t* indicates the average number of minutes required for each score point for different ages. The ages are shown on the base line.

TABLE III.

	Age.						
	8	9	10	11	12	13	14
Average number of minutes to make one score point.....	1.05	.81	.65	.55	.48	.42	.37
Decrease over previous year...		.24	.16	.10	.07	.06	.05

From a consideration of the data of tables II and III and of Figure I it is obvious that one might come to different conclusions as to the constancy of the rate of mental growth as indicated by performance at different ages, according to whether one considers *how much work is done in a unit of time,* on the one hand, or *how much time is required for doing a definite unit of work,* on the other. It is to be

noted that in either case here one considers absolute increments or decrements. The conclusion from this consideration seems to be that we cannot read off mental growth directly from either of these score changes, as Freeman seems to have done from one of them.

The error here indicated is similar to one that has lurked in the inferences from learning curves as to the rate of learning, first pointed out by the writer, so far as he is aware, is 1917[3], an error still persisting in certain recent articles on learning, even though the author in one case has explicitly noted our criticism and thinks he has avoided the error.[4] The error in question here is also similar to one in the statistical determination of averages, which was pointed out by Rugg simultaneously with our own statement of it as applied to learning.[5] In dealing with curves of complex functions, or with the data that such curves represent, it is essential that we do not neglect the possible effect of factors of importance that are not in evidence.

It is, of course, interesting to know of any test norms that the increment from year to year is about constant, and also to note when and how this increment begins to change with the approach of mental maturity; and such knowledge may be useful in many practical ways, even though applications such as we have questioned in this paper cannot be made in any direct manner. Such constancy of increase, however, does not necessarily indicate that a test is a good *mental* test, or even that it discriminates well the different degrees of intelligence known to exist in successive year-points in mental development. Moreover, other factors should be considered or controlled in interpreting such data. For example, let us suppose that the children become fatigued in inverse order to their ages—an assumption that is not unreasonable in long tests—and that therefore the attention and application in any test period constantly decrease, thus preventing the younger children from using profitably all their time. This will obviously lower their score beyond what more fair conditions would make it. Now if this effect appears early and gradually decreases with advancing years, it may exactly balance and therefore cover up the effects of real mental changes that we are attempting to measure; or it may tend to exag-

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[3]Peterson, Jos. Experiments in Ball-tossing: The Significance of Learning Curves. *Jour. Exp. Psychol.*, 1917, 2, 178-224.

[4]Perrin, F. A. C. The Learning Curves of the Analogies and the Mirror Reading Tests. *Psychol. Rev.*, 1919, 26, 42-62.

[5]Rugg, H. O. *Statistical Methods Applied to Education*, 1917, 126-132.

gerate them. We are not trying to indulge in a hair-splitting exercise regarding this matter, but desire to show that a time element cannot be safely disregarded in the comparison of different norm curves taken as indicators of the rate of mental growth.

With reference to the problem before us, the successive yearly increments of mental growth in children, it is probably obvious that we can yet say but little with confidence, however useful the various intelligence tests have become in the applications of psychology. The article in question is far from making dogmatic conclusions, and its cautions regarding the applications of the IQ to other scales than the Binet, from which it originated, is timely; but if the criticisms here offered are well founded it is well to abstain from conclusions as to the absolute growth of intelligence, based only on norms of average attainment per unit of time. If the constancy of the IQ is supported by more extensive research than has been made we shall probably have to accept the view that mental growth curves diverge and also that they decrease in rate with advance of age, though it is very questionable that the logarithmic curve will be found to correspond strictly to these curves at their extremes.

COMMENTS ON PROFESSOR PETERSON'S CRITICISM.

F. N. FREEMAN,
University of Chicago.

The point which Professor Peterson makes with reference to the unit to be used to measure achievement in the age progress curve is worthy of consideration. In discussing it, we should distinguish clearly between two aspects of the question. My original paper dealt first with the use of the IQ as a measure of the mental capacity of the individual in connection with various scales, and, second, with the nature of intellectual progress as indicated by the scores obtained with these scales.

My argument concerning the IQ is not affected at all by Peterson's criticism, for the reason that it deals simply with the units which are actually used in these scales and not with the units which might have been used. Any person who uses the Otis scale, for example, will naturally score the pupils according to the units which Otis uses, namely, number of points; and the question whether the ratio of mental age to chronological age is a suitable measure has to be considered with reference to the type of age progress and distribution within each age which is found to exist in the measures which are actually used in scoring the test. For this reason, I did not, as Peterson implies, "apply to the Binet scores . . . inferences of this nature from scores derived under this time limitation."

Let us be clear on another point before proceeding further. My statement concerning the form of the progress curve might have been worded as follows and still have retained its chief significance: "The age progress curve *when expressed in terms of annual increments of point score* appears to be approximately a straight line." The significance lies in the comparison of such age progress lines with others, *all of which have been obtained with the same kind of units.* Whether or not what appears to be straight linearity by such units is really such, or is only something which more nearly approaches straight linearity than has been obtained from so many of the single tests—such, for example, as are reported by Pintner and Paterson in their *"Scale of Performance Tests"*—is a question chiefly of theoretical interest.

The theoretical question whether it is better to express growth in terms of absolute increments of score or relative decrements of time seems to me one which is open to debate. Peterson scouts the idea that an advance from .95 to 1.24 points per minute is indicative of the same growth as an advance from 2.38 to 2.67 points. Apparently the reason these two intervals seem so different is the fact that the lower scores are so much nearer the zero point than the upper ones. But we cannot take such an appearance, when we are dealing with data of this kind, at their face value. Suppose that the decrements shown in Peterson's Table II should be found to continue downward, as shown below. The series would reach the zero point

	Age.									
	5	6	7	8	9	10	11	12	13	14
Points per minute.	.09	.38	.66	.95	1.24	1.52	1.81	2.10	2.38	2.67
Minutes per point.	11.11	2.63	1.82	1.05	.81	.65	.55	.48	.42	.37

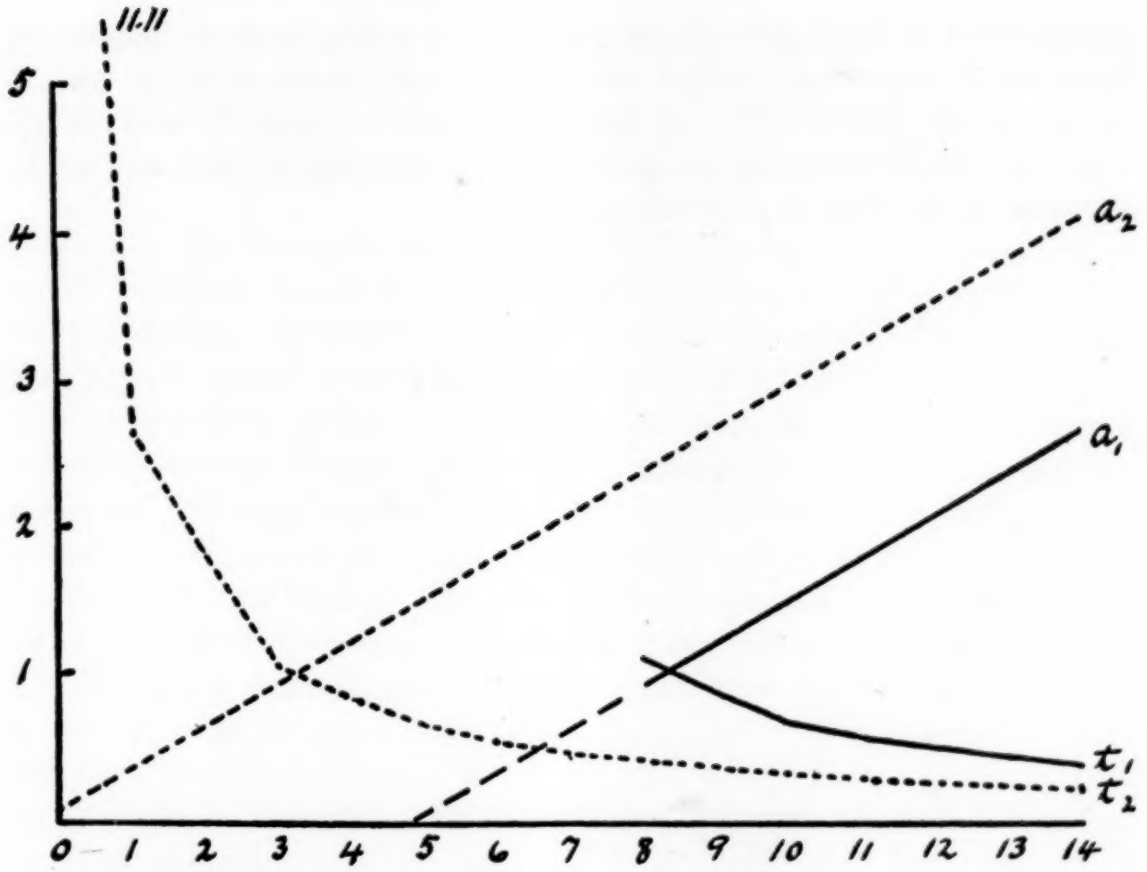
somewhere between ages 4 and 5. Obviously this is not the point of beginning of mental growth. The test is more difficult than it would have to be if a zero score represented zero ability.

The origin and the form of the time curve at given ages is affected by this difficulty level of the test. Thus in the present hypothetical extension of the curve downward the time curve reaches infinity between the ages of four and five.

Suppose that the whole level of scores were raised through the addition to the scale of easier tests enough to bring the zero score approximately to zero age with a continuance of the straight-line progress. This would be done by adding 1.43 points per minute to each score above age 5. Our series of scores would then run as follows:

	Age.														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Points per minute	.09	.38	.66	.95	1.24	1.52	1.81	2.09	2.38	2.67	2.95	3.24	3.53	3.81	4.10
Increment		.29	.28	.29	.29	.28	.29	.28	.29	.29	.28	.29	.29	.28	.29
Minutes per point	11.11	2.63	1.82	1.05	.81	.65	.55	.48	.42	.37	.34	.31	.28	.26	.24
Decrement		8.48	.81	.67	.24	.16	.10	.07	.06	.05	.03	.03	.03	.02	.02

The numerical quantities are shown graphically in the figure. The form of the progress curve which is based on the time units for ages 9 to 14 is seen to be altered very seriously by the hypothetical read justment of the level of scores to bring the zero point of the test more



a_1, Norms for the Otis Scale in points per minute.
t_1, Norms for the Otis Scale in minutes per point.
a_2, Norms for the Otis Scale hypothetically raised to a higher base and extended downward in points per minute.
t_2, Norms represented in a_2 expressed in minutes per point.

nearly where we should expect zero ability to exist, but the form of the curve based on points is not affected. This procedure, of course, is somewhat arbitrary, but it seems to me sufficiently valid to indicate that there is serious question of the validity of the time unit method.

There is one other diffculty with the theoretical basis for the time unit method, and that is the assumption that tests of the sort we are discussing are purely speed tests. Most of them do, it is true, employ a time limit. But a still more important feature of their organization is the progressive increase in the difficulty of the parts of each test. The higher scores, therefore, represent not merely, or perhaps not chiefly, greater speed, but ability to do a more difficult task; and insofar as the higher score does represent greater speed the speed may be regarded as the outcome of greater power in performing the task rather than as greater quickness in itself. We are

accustomed to base growth curves of other sorts, such as height, on increments in amount rather than on proportionate increase, and it seems to me conceivable, at least, that mental growth may be at least as closely analgous to growth by increments of this sort as to increase in the rate of performance.

TIME AND ACCURACY AS RELATED TO MENTAL TESTS

E. LEIGH MUDGE,
Edinboro, Pa., State Normal School.

During the Autumn of 1920 the writer gave to the junior class of the Edinboro State Normal School the group test of general intelligence devised by Thurstone, and gave to the senior class the test prepared by Otis. A considerable number of inconsistencies between test scores and academic standing led him to wonder if certain valuable mental elements may not be disregarded by these and similar tests. Certain students who ranked relatively low in the tests seemed to do more accurate and careful school work than others whose rank was higher. Certain students seemed to feel peculiarly handicapped by the time limit imposed in giving the tests. Others, working at a much higher rate of speed, were able to make higher scores in spite of many inaccurate responses. Was it possible that the high scoring students were securing speed at too great a cost in accuracy? Granting the importance of quick responses in many or most situations, is not accurate work relatively undervalued in these tests? A series of nine group tests without time limit was devised for the study of these problems. These tests demand thought and carefulness but do not involve such a range of problems, from easy to difficult, as would be necessary for a thorough reasoning test. They are chiefly tests in accuracy in a variety of tasks involving reasoning, observation, memory, and other mental functions, especially accuracy in following directions. The only values which may legitimately be used in comparing the records of these tests are relative ranks in each test. Diagram 1 shows the relation between twenty rank-groups in the Thurstone test and the average rank of the same groups in the accuracy tests. The horizontal measurement indicates the Thurstone ranks, from left to right. The altitude of the curve indicates average rank in the accuracy tests. For example, those who are in rank 12 in the Thurstone test are of the average rank of 9 in the accuracy tests. The diagonal straight line is the line which the curve would follow if there were a perfect correlation between the rankings of the two tests. Diagram 2 follows the same plan, save that there are 13 instead of 20 ranks.

DIAGRAM 1 (57 JUNIORS) THURSTONE TEST AND ACCURACY TEST COMPARED

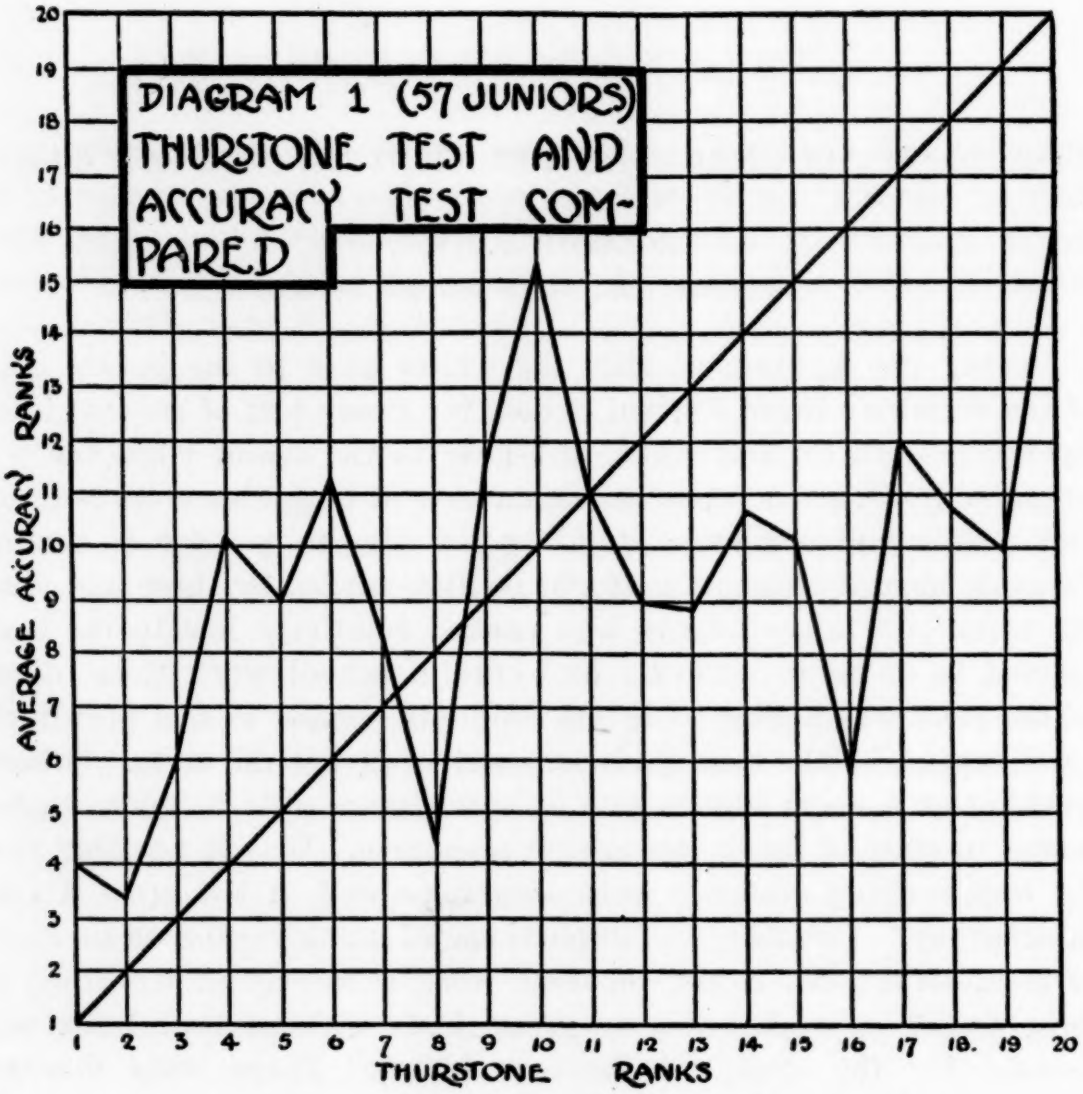
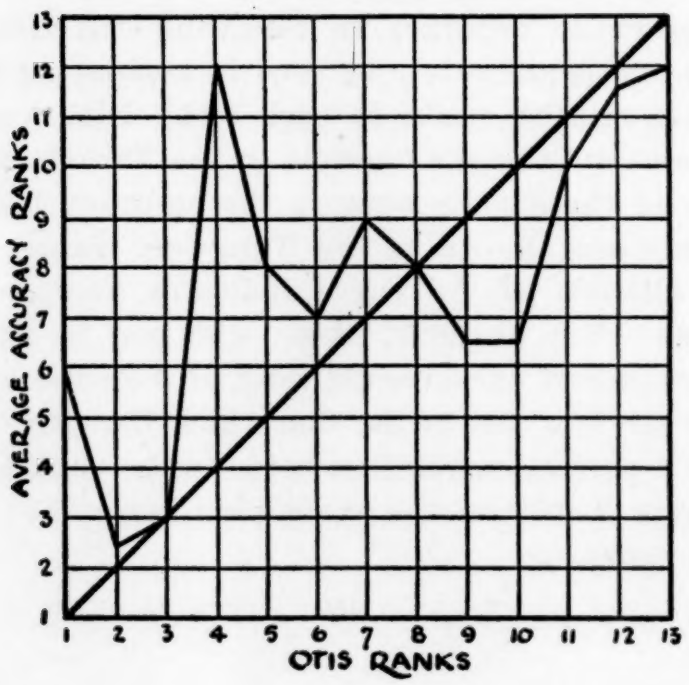


DIAGRAM 2 (20 SENIORS) OTIS TEST AND ACCURACY TEST COMPARED



The striking similarity between these two curves appears to indicate, at least for this institution, some significant tendencies. Granting that the Otis and Thurstone tests are dependable measures of general brightness, and that accuracy of work, at least under the conditions described above, is measurably indicated by the tests devised by the writer, the following tendencies are observable:

1. The very few brightest students tend to be the most accurate, and the very few dullest students tend to be the most inaccurate.

2. Aside from these extremes, the brighter students tend to be relatively *less* accurate and the duller students to be relatively *more* accurate. The reason for this may lie in an educational fault. Is there not a tendency to accept relatively careless work from the brilliant, rapid-working student, and does not the student himself feel that more is to be attained by working rapidly though carelessly than by spending more time at a given task?

3. There are persons who are relatively inefficient in such timed intelligence tests as we have used, who are able to do relatively efficient and accurate work when allowed to work more slowly.

4. There are persons who are relatively efficient in rapid work, who are relatively careless and inaccurate, even when they may work more slowly.

The educational bearing of these observations seems clear. Since accuracy in observation and work is highly desirable, the schools should provide such work for the slower group as will develop the habits of careful work through which they may render their best service. The schools should likewise seek to so adapt their work to the brighter students as to more effectively motivate accuracy. Beyond a doubt, society needs people who think and act quickly, but their usefulness may be increased as they develop habits of greater accuracy and carefulness in their work.

DEPARTMENT FOR DISCUSSION OF RESEARCH PROBLEMS

Conducted by LAURA ZIRBES

This department has a two-fold function. It aims to serve research workers as well as educators, whose work brings them in close contact with children in the schools. It hopes to accomplish this service by suggesting research studies, which will meet well-defined school needs.

In order that this service may be real and effective, the co-operation of research workers and school people is desired. Correspondence with reference to the following questions will be considered in selecting topics for future discussions.

a. Which of the studies proposed would help you to solve a practical problem?

b. What topics might well be added to this list? Replies may be addressed to: Miss Laura Zirbes, 646 Park Ave., New York City.

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1. *Studies in the psychology of practice which does not have an automatic response to a particular situation as its end.* The effect of mere recall without reorganization of elements. Experimentation to determine the value of diverse associations and reorganization of experience as a device to promote learning, recall, and transfer. Psychological differences in learning due to difference in purpose and content of instruction as illustrated by comparing psychological processes involved in learning addition combinations or mathematic formulae with learning the meaning of historical movements or geographical influences.

2. *A study of the effects of specific training in the appreciation of quantity and quantitative thinking on the ability to solve quantitative problems.* A study of the social value of the ability to realize and manipulate mentally number relations, followed by an experimental determination of socially valuable practice material.

3. *The effect of various types of motivation on performance in tests and practice materials.* Variation of individual scores due to desirable or undesirable attitude. Possible economy resulting from well motivated practice. Comparison of results of same motivation on children of different grades and ages. Evaluation of various types of motivation with reference to the particular needs of subject matter.

WHAT ARE THE SITUATIONS IN WHICH READING FUNCTIONS?

A scientific determination of procedure and content in the teaching of reading cannot proceed without a careful study of the situa-

tions in which reading functions. Present progressive practice as well as new reading textbooks show the influence of studies which have resulted in the re-appraisal of oral and silent reading. But a further analysis is necessary if instruction is to receive a full measure of the benefits which accrue from psychological studies and educational research.

Granting that the ideal curriculum represents the social values from the accrued experience of the race which the best judgment of this generation considers of such great importance, that they should be made available to all the members of the succeeding generation, does it not follow that the following questions can only be answered by careful research and investigation?

1. What do various types of American citizens read of their own choice? (What relation has this to the problems of recreation and citizenship?)

2. What does an American citizen need to read in order to pursue the round of activities which the intelligent performance of his duties as a citizen demands?

3. How can we, in our educational program, provide a sufficient variety of reading experiences and desirable types of training to demonstrate to learners the social significance of reading?

4. What are the special study habits and attitudes which make reading an effective tool in the pursuit of learning?

5. What aesthetic and recreational experiences depend on the cultivation of an interest in books and on the possession of means and ability to satisfy interests by reading?

Our times certainly make a wide range of demands on reading abilities. There is, perhaps, no school subject which compares with reading in making life significant. A great many people are able to evade the necessity of writing and making arithmetical calculations without seriously limiting their own efficiency or interfering with the enjoyment of leisure. But there are few indeed who can so easily evade reading even for a day, nor do they desire to do so. Individual reading abilities limit the amount read and are, in a large measure, responsible for kinds of material selected. While it might be interesting to study the actual reading habits of a random sample of our population, it would hardly be wise to use the results for determining the types of abilities which the school should try

to perfect. We should rather seek to provide every future citizen with a sufficient range of reading abilities to enable him to keep abreast of the times in the performance of his civic, economic and recreational responsibilities.

By an analysis of the reading content of papers, current magazines, and books, we find that there are many kinds of reading matter, each requiring special motivation and special abilities. The following list is by no means exhaustive: Easy narration, description, current news, articles, essays or editorials, correspondence, technical and scientific information, poetry, diagrams, charts and tables, summaries, jokes, serious business announcements, minute directions, etc. When various interests and abilities have not been developed it is not surprising to note that the corresponding materials are not read. Answers to the following questions would be illuminating:

1. What is the most widely read part of the Sunday newspapers?
2. What percent of the subscribers habitually read the editorials?
3. What percent of the population reads a foreign language by preference?
4. Who are the subscribers to the various types of magazines and how does the constituency vary?
5. What could be learned of the reading habits of various factors of our population by a study of the records of public libraries?

The mere statement of these problems leads to the formulation of others depending on the sociological definition of reading outcomes.

Silent reading has been stressed since its social significance be came apparent. A great number of special habits depend largely on carefully designed training and experience. The mere pursuit of silent reading may lead to a very one-sided performance. We are beginning to realize that there are many silent reading abilities and that training to be economical and effective must be special. This can be easily demonstrated by tests.

Test material which consists of a very simple story to be read without interruption or reproduction must obviously be supplemented by other tests if a true measure of the pupil's ability in situations which involve reading is to be gained. If, as is apt to be the case, practice is redirected with reference to the requirements held up in tests, it follows that groups of tests should be designed to cover

the many socially desirable types of performance in which reading is a more or less dominant factor. This does not abrogate the usefulness of some of the carefully standardized tests, but it does indicate that there are gaps which need to be filled by the suggested tests.

This suggestion leads to another. After an experimental determination of the reading curriculum, the abilities which are involved must be analyzed psychologically to the end that the technique of instruction and practice with desirable content may be built up on a scientific basis. This, in turn, implies the necessity for diagnostic and remedial measures, for instructional practice material based on the psychology of reading tested and evaluated by the changes in ability which they produce under carefully controlled conditions.

Although some phases of reading have been very carefully and thoroughly investigated, further research along the lines suggested must make available to the profession scientifically established standards to be met by materials and methods of instruction.

If this discussion leads to the investigation of any of the problems suggested, this department will welcome an opportunity to outline more fully the field of investigation and possible ways and means of carrying out the suggestions offered.

LAURA ZIRBES.

The Lincoln School of Teachers College.

NOTES ON ARTICLES IN EDUCATIONAL PSYCHOLOGY IN CURRENT ISSUES OF OTHER MAGAZINES

1. Articles on Tests.

An Experiment in Arranging High School Sections on the Basis of General Ability. Ernest P. Branson. Journal of Educational Research. January, 1921. 53-55.

Suggestions for Procedure Following a Testing Program. B. R. Buckingham. Journal of Educational Research. December, 1920. 787-801. Recommends re-classifying and working with individual pupils after giving group test. Gives the first bibliography we have seen on this problem. Bibliography deals with both educational and mental tests.

A Group Intelligence Examination Without Prepared Blanks. J. Crosby Chapman. Journal of Educational Research. December, 1920. 777-786. Description of make-up, scoring, and validity of such tests.

Recent Results Obtained from the Otis Group Intelligence Scale. Stephen S. Colvin. Journal of Educational Research. January, 1921. 1-12. Clear and adverse criticism of the norms recommended for the Otis tests. Gives several helpful tables of coefficients correlation between intelligence and their important criteria.

The Measurement of Intelligence. V. A. C. Henmon. School and Society. February 5, 1921. 151-157. Vice-presidential address; a survey of recent accomplishment in the intelligence field. Points out strength and weaknesses of our present procedure.

Group Intelligence Tests as a Means of Prognosis in High Schools. I. N. Madsen. Journal of Educational Research. January, 1921. 43-52. Typical of articles frequently appearing which give statistical results of using the Army Group Test.

Studies in High-School Procedure—Half-Learning. Henry C. Morrison. The School Review. February, 1921. 106-118. General destructive criticism of the use of intelligence tests, and concerning statistical measures such as the probability curve. Educational psychologists and statisticians interested in the use of such measures should read this article.

A Comparative Study of the Intelligence of White and Colored Children. R. A. Schwegler and Edith Winn. Journal of Educational Research. December, 1920. 838-848. Summarizes and interprets previous studies; presents good bibliography of 17 items. Conclusions based on Binet tests of 116 Junior High School girls.

A Comparison of Three Methods for Making the Initial Selection of Presumptive Mental Defectives. J. E. Wallace Wallin. School and Society. January 8, 1921. 31-44. Presents valuable correlation data for group and individual tests (Pressey and Binet); argues for the competency of school staffs to estimate the abilities of pupils.

Intelligence and Industrial Tests in Institutional Administration. Edgar A. Doll. Journal of Delinquency. 1920, 5, 215-224.

Practice Effects in Intelligence Tests. Knight Dunlap and Agnes Snyder. Journal Experimental Psychology. 1920, 3, 357-377. Taking the Army Alpha four times increases ability considerably in such works.

Mental Tests. F. N. Freeman. Psychological Bulletin. 1920, 17, 353-363. A critical survey of 48 recent articles.

The Block-Design Tests. S. C. Kohs. Journal Experimental Psychology. 1920, 3, 357-377. Describes a new "performance" test for general intelligence.

Suggestions Looking Toward a Fundamental Revision of Current Statistical Procedure as Applied to Tests. Sydney L. Pressey. Psychological Review. 1920, 27, 466-472.

2. Articles on the Rating of Human Character.

Character vs. Intelligence in Personality Studies. Guy G. Fernald. Journal Abnormal Psychology. 1920, 15, 1-10. Points out the need of evaluating "personality," "temperament," etc., for supplementing intelligence ratings.

What Should Teacher-Rating Schemes Seek to Measure? Raymond A. Kent. Journal of Educational Research. December, 1920. 802-807. Suggests another scheme for rating teacher as a professional worker.

The Construction of a Teacher-Rating Scale. C. A. Wagner. The Elementary School Journal. January, 1921. 361-366. Concerning new teacher's rating scale and recommends "the use of 'suggestions'" as the unit of measurement of teaching qualifications.

3. Miscellaneou. Articles.

Exicitability in Delinquent Boys. Mildred S. Covert. Journal of Delinquency. 1920, 5, 224-240.

Personality from the Introspective Viewpoint. Harold I. Gosline. Journal Abnormal Psychology. 1920, 15, 36-45.

The Public Schools and the Treatment of Delinquent Children. Lilburn Merrill. Journal of Delinquency. 1920, 5, 207-215.

Correlation. J. B. Miner. Psychological Bulletin. 1920, 17, 388-396. A summary of 42 articles.

Child Psychology. D. Mitchell. Psychological Bulletin. 1920, 17, 363-775. A summary of 48 recent articles—Educational Psychology. C. T. Gray. Psychological Bulletin. 1920, 17, 375-387. A summary of 103 articles.

The Psychology, Biology and Pedagogy of Genus. L. M. Terman and J. M. Chase. Psychological Bulletin. 1920, 17, 397-410. A summary of 95 articles.

Do We Think in Words? Arthur S. Otis. Psychological Review. 1920, 27, 399-420. A criticism of the treatment of mental processes by John Watson in 'Psychology from the Standpoint of a Behaviorist.'

The Effect of Fatigue on Attention. John J. B. Morgan. Journal Experimental Psychology. 1920, 3, 319-334. Fatigue effects measured by amount learned, retained and recognized as a result of 4 hours' continuous work in memorizing German words.

Effects of Smoking on Mental and Motor Efficiency. Sven Froeberg. Journal Experimental Psychology. 1920, 3, 334-347. The maderate use of tobacco appears to have little effect upon mental work.

NEW PUBLICATIONS IN EDUCATIONAL PSYCHOLOGY AND RELATED FIELDS OF EDUCATION

1. *A report on the experimental evaluation of factors which contribute to effective silent reading.* The studies reported in this yearbook will no doubt play a significant part in the determination[1] of further research. Several of them are serious attempts at an experimental evaluation of procedure in the teaching of silent reading. W. W. Theisen's contribution is a summary of experimental evidences and current thought concerning fourteen factors affecting results in primary reading. The evidence presented warrants the conclusion that intelligence is probably the most significant factor, although this has never been sufficiently recognized.

Other factors discussed are regular attendance, home influences, amount read, difficulty of material, interest, supervision, and quality of teaching. The studies from which information is drawn are listed in a bibliography. Dean Gray's article deals with the individual difficulties of five pupils in the intermediate grades, and demonstrates the value of careful psychological diagnosis and prescription. John A. O'Brien reports a study of the development of speed in silent reading. Twelve factors are listed. Three types of training were especially devised to incorporate the factors listed. There is a report of a carefully controlled experimental evaluation of the training resulting from its use on approximately 1200 pupils and an interpretation of the results.

The article on motivated drill in silent reading makes practical suggestions, which are much needed in the re-direction of instruction. The value of intense focalization, keen interest and individual activity are demonstrated.

The value of a single reading has, no doubt, been greatly overestimated according to the study reported by A. Yoakum. Suggested methods for careful reading and motivation are submitted in an article by C. E. Germane and Harry A. Greene. Chapters IX

[1]The National Society for the Study of Education. Twentieth Yearbook, Part II. *Report of the Society's Committee on Silent Reading.* Bloomington, Ill.: The Public School Publishing Co., 1921. Pp. IX + 172.

and X by J. L. Packer and Daniel Starch respectively, deal with the vocabulary and content of readers.

In Section II of the Yearbook are assembled a number of interesting exercises all of which have seen classroom use. The group of exercises and suggested scale offered by P. R. Heller and S. A. Courtis are an interesting combination of drawing and reading which should appeal to primary children. They suggest the possibilities of improving educational practice by submitting practical suggestions based on phychological research and classroom experimentation.

The chapter by Dr. Burgess is an abstract from a monograph mentioned elsewhere in this issue of the Journal. L. Z.

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2. *A comparison of six group intelligence tests.*[2] This is a very interesting intensive study of six group intelligence scales which were given in the schools of Champaign, Illinois. The chief purpose of the author was to compare and contrast these six scales from the standpoint of their efficiency and adaptability as measuring instruments for general school use. With this end in view, he considers the time consumed in administering the tests, the correlations with scholarship, the correlations between the different scales, the reliability of the total scores and the like. This is all very good and of great interest to the psychologist engaged in mental testing, but much of it would be too technical for the practical worker in the field. It is possible, however, that the practical worker might be led to accept some of the easily comprehended conclusions that the author arrives at rather dogmatically in attempting to summarize his comparisons of the six scales. This summary seems to show the Vocabulary Test (Holley's) superior in more points to the other five scales (Otis, Theisen Classification, Whipple's Group, Pressey Primer, Haggerty Delta 1). The conclusion that the Vocabulary Test is the best test to use in Grades 3 to 12 might easily be made by the uncritical. The critical reader will not be so readily convinced that the author has chosen all the important criteria for judging a scale and he will also note no attempt to evaluate the importance of the criteria chosen. Nevertheless, we need more studies of this type at the present time when group scales of all sorts are appearing

[2]Holley, Charles E. *Mental Tests for School Use.* Bureau of Educational Research, Bulletin No. 4. University of Illinois, March 8, 1920. Pp. 91.

in great numbers. The emphasis should be laid upon trying to discover for what particular purpose any specific scale is adapted.

In addition to this discussion of the six scales the author presents the results of the survey of the schools of Champaign and his presentation of the data should be useful to superintendents and others who are planning mental surveys of their school system.

The first part of the monograph gives a very readable discussion of the value and uses of mental tests in general, as well as a description of what is meant by general intelligence and what mental tests can and cannot do. This part of the monograph should serve as a splendid introduction to the beginner in the subject.

R. PINTNER.

Ohio State University.

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3. *An important treatise on educational measurement.* Dr. May Ayres Burgess's new book, "The Measurement of Silent Reading,"[3] is of such striking importance that the editors have decided to organize about the discussion of it a critical symposium on educational measurement. This we trust will be published in the May issue. At the present time, therefore, we supply merely a brief statement of what Dr. Burgess has done. The book makes three types of contribution to education. First, it reports a new scale for measuring ability in silent reading. Next, it presents a careful critique of the construction of scales in silent reading. Third, it is a very careful analytical study of the construction of educational scales in general. Fundamental issues of technical scale construction and of educational thinking have been raised—issues which should be debated vigorously.

H. O. R.

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4. *Presentation of a history test.* A recent monograph by Dr. M. J. Van Wagenen[4] points the way to much more objective methods of testing in the field of United States history. This study describes how questions involving facts, thought and character judgment were standardized so that these commonly emphasized aims could be accurately measured.

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[3]Burgess, M. A. *The Measurement of Silent Reading.* New York: Russell Sage Foundation, 1921. Pp. 163.

[4]Van Wagenen, M. J. *Historical Information and Judgment in Pupils of the Elementary School.* Teachers College, Columbia University, Contributions to Education, No. 101.

These questions were derived from a preliminary test given to 1200 children in three public schools of New York City in grades 4-8 and from revised tests taken by 2000 more pupils.

Van Wegenen lists five desiderata for measuring historical abilities: First, that "the tests be symptomatic of important abilities really desired by the schools." The outcomes tested are important ones, though facts are valuable mainly for use in solving problems, in making judgments and in interpreting historical situations. It is to be hoped that this investigation will stimulate others to complete the standardization of the objectives of history teaching. Only in this way can we obtain a scientific statement of what the aims of historical instruction are. His second thesis is that "the tests be not too much disturbed by linguistic difficulties so that ability in history, not in reading and composition, may be chiefly measured." His results, in general, accord with this desideratum. Third, "that the measurement of a small group, such as a class of twenty-five or more, may be made with sufficient precision." A correlation of above .7 between each type of test is obtained. Also detailed tables of the degree of difficulty of the questions with a "key" for the scoring of the same makes possible accurate measurement of a class. However, if he would also transmute his scores into the familiar percentage scheme with the value of each question on that basis indicated on the teacher's scorecard, it would be much more helpful to the history teacher. His fourth point that "the tests be capable of extension to alternative forms so as to reduce harm done by coaching" is taken care of in these scales by including 70 Fact, 44 Thought and 40 Judgment questions. These together well exhaust the content of United States History. Fifth, the last criterion that "the administration and scoring of the tests be convenient" is illustrated by the fact that fifty minutes is sufficient to exhaust the abilities of all save a few and that the scoring can be done relatively accurately by the average history teacher by means of his "key." E. U. RUGG.

Teachers College, Columbia University.

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5. *A report of use of tests.*[5] The students of a summer course in experimental education under the direction of Baldwin were each given a specific piece of work in tests and measurements. These

[5]Baldwin, Bird T., and others. *Studies in Experimental Education.* The Johns Hopkins University Studies in Education, No. 3. Baltimore, 1920. Pp. 75.

experiments were conducted by the students in a small demonstration school of six grades containing 129 pupils "who represent, in most instances, examples of maladjustment in educational progress." The tests conducted by these university students were written up and form eleven articles in the monograph. These studies give the results of the following tests: Yerkes Scale, Terman Scale, Courtis Arithmetic, Woody Arithmetic, several handwriting scales, Kansas and Starch Reading, several spelling scales, Trabue Completion, Hillegas and Ballou Composition.

Naturally the results obtained on a small group of children under the circumstances described could not be expected to be of great importance. No particularly new line of attack is followed in any of the studies. Some of them stress the data obtained and others attempt some discussion or criticism of the tests themselves. Some of the studies hardly go further than a clear presentation of the data. It might rightly be questioned whether students' themes of this type warrant publication in a university monograph or, indeed, whether they warrant publication at all. To the reviewer what justification there is would seem to lie mainly in the stimulus to advanced study and independent research which such an undertaking might give the students concerned. There can be no doubt that a group of students working towards the publication of their studies would be stimulated thereby. The whole monograph, therefore, forms a splendid example of the project method applied to the study of mental and educational tests. It shows moreover how well adapted to the project method is the study of this phase of educational psychology. In this field individual and group projects can be used very effectively.

The first chapter of the monograph is a summary of the students' work by Baldwin himself, in which he attempts to correlate all the separate studies. The presentation of a great many correlations of such a heterogeneous and small group of pupils does not help us very much. The developmental graph of the circular type combining all the various ratings of a particular child is interesting.

The monograph should be read by all teachers of university classes in tests and measurements in order to get some idea of how the project method may be applied to their classes.

R. PINTNER.

Ohio State University.

6. *Psychological factors involved in social reconstruction.* That the facts and principles of "dynamic" psychology are being studied and applied by students of sociology is clearly evident in a recent book by Professor Patrick.[6] Following somewhat the trend of the late Carleton Parker, the author amplifies the thesis that society must be reorganized "not on a basis of adequate scale of living, material comforts, wealth or efficiency" but "to satisfy instinctive needs" and to "furnish a field for human activities." Accepting, in the main, the fundamental impulsions or "instincts" listed by James, McDougall and Thorndike, the author considers, in terms of these, the motives behind many present day activities ranging from the movies, dancing and smoking to crime, war and anarchy. The human animal, driven by numerous inborn impulsions, fails to satisfactorily exercise them under conditions of modern industrial and social conditions, consequently a myriad of indirect expressions,—"sublimations"—of the undesirable sort appear. In general, it will be gratifying to many, that Professor Patrick has handled his thesis without resort to the fantastic explanations of the Freud-Jung-Adlertype. He restricts his principles rather well to the recognized findings of science, carrying the interpretations to remote fields, to be sure. The psychologist will object to a neglect of established facts of individual differences. Professor Patrick's humans as assembled, are too much of a mould; in particular they are too similar to the exceptional man in their interest in thinking, problem solving and creative work. In social reorganization, what is urged is the adaptation of the environment and work to the needs of the man, and what is needed is a scientific study of the "wants" of man to discover which may be changed through education, which persist in whatever environment. The book is important because it rebels against the "strange forgetfulness of the fact that however important social and political readjustments may be, the world cannot be made over as long as human material—the minds and bodies of men—remain the same." A. I. G.

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7. *A Yearbook of New Project Materials.* Part I of the Twentieth Yearbook of the National Society for the Study of Education[7]

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[6]Patrick, George Thomas White. *The Psychology of Social Reconstruction* Boston: Houghton Mifflin Company, 1920. Pp. IX + 273.

[7]The Twentieth Yearbook of the National Society for the Study of Education, Part I. *Second Report of the Society's Committee on New Materials of Instruction.* Bloomington, Ill.: Public School Publishing Co., 1921. Pp. XV + 237.

consists of a collection of 285 projects compiled by a committee of eleven who drew upon more than 100 members of subcommittees. The materials, classified by grades from the kindergarten to the sixth grade, inclusive, are given 115 pages, in which 193 projects are described. Projects numbering eighty are classified by subjects for the Junior High School. Ten projects for special classes are listed. The book includes an annotated bibliography of 404 titles, classified under 38 headings. It is by far the best collection of concrete samples of project teaching which has appeared. A. I. G.

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8. *The Project Method in Education.* A Riverside Educational Monograph,[8] deals in an intelligible manner with the theory of teaching by projects, with a series of illustrative "projects" in history, civics, manual arts, agriculture, current events, etc. A project "is no more or no less than the natural concrete expression of modern principles of education in practice." What the modern principles of education are is shown in the first three chapters by tracing their development from Rousseau through Pestalozzi, Froebel, Herbert, and in turn the growth of their influence in America, eventuation in a brief exposition of the doctrines of James, Thorndike, Dewey, McMurry and others. "Development through natural processes," "natural interaction with the environment," "self expression through activity," "learning to do by doing," "self activity at work solving problems," etc., are general terms rather frequently repeated which the author attempts to illustrate in some detail. Compared to certain recent writings, Mr. Stockton's recommendations are conservative. He makes no fiery denunciation of existing conditions. He does not recommend the abolition of established school subjects although he would seek more fruitful attack upon them. "It is safe to say that the keynote of the new spelling [for example] is that spelling must be definitely *taught*—that mere 'exposure' is too uncertain." He would merge several subjects; e. g., "geography, elementary science, nature-study, school-gardening, history, civics, current events, and primitive life may be reduced without loss to history and geography." He believes in adult interference in a case where we cannot expect that the child "will absolutely form his own

[8]Stockton, James Leroy. *Project Work in Education.* Boston: Houghton Mifflin Company, 1920. Pp. XIV + 167.

opinion about it," and if he persist in undesirable conduct "he is finally even put into restraint."

Perhaps most important is the recommendation that we must begin "really *to teach children how to study,* through making children themselves conscious of the definite factors involved." "It is no longer possible to teach all of the multitudes of facts accumulated by the race; but it is possible to develop 'methods of attack' which will make the student independent in his solutions of difficulties as they arrive. A good course in 'How to Study' or 'How to Think' fulfills this purpose." If Dr. Stockton is a little optimistic in his claims for the methods he describes, he nevertheless succeeds in stating rather effectively a good many issues. The book will render service as a very summary introduction to modern educational theory and practice; it is too summary, of course, to be useful as a concrete guide to practice. A. I. G.

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9. *A New Spelling Book.* Research upon the problems of spelling is perhaps producing a closer approximation to a scientific subject-matter and method than in any other fundamental study. For a number of years Professors Horn and Ashbaugh have been conducting investigations in both fields and their spelling book,[9] just off the press, is unquestionably more scientifically constructed than any which has yet appeared. The vocabulary consists of a minimum list of 3998 words which appeared most frequently in some 700,000 running words of correspondence, the result of nine different studies. Supplementary lessons for each grade include 580 additional words. The words are apportioned to each of the eight grades, with the difficulty (standard number of errors for each column of 10 or 20) given at the foot of the column. The grading of words is based upon three factors; 1) the frequency of use in correspondence; 2) the difficulty of the words as shown on the Ashbaugh Scale, and 3) the frequency with which the word appears in representative first, second and third grade readers. An important addition to the usual spelling scale is a list of abbreviations and names of states, common measures and conventional commercial and professional titles. A list of 50 "demons"—the most difficult words of the Ashbaugh scale—are found in a series of dictation letters at the end of the book.

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[9]Horn, Ernest, and Ashbaugh, Ernest J. *Lippincott's Horn-Ashbaugh Spelling Book.* Philadelphia: I. B. Lippincott Company, 1920. Pp. XX + 105.

While the grading, especially above grade IV, is not perfect, the list as a whole is a distinct improvement over others now available.

The method of teaching and learning to spell, essentially as reported by Professor Horn in the 18th Yearbook of the National Society for the Study of Education, is distinct departure from convention. The words are listed in columns of 20 each (10 in grade I). There are no jingles, no pictures, no groupings, no rules, no underlining of difficult parts, no heavy face type, no stunts of any sort. One method is described for learning to spell a word. The pupil masters the method and then attacks a word which is learned through sheer habituation. It is assumed that the learning of each word is specific. Each child is enabled by a weekly system of tests and reviews to attack only those words which offer difficulty. Provision is made for systematic review on Monday, Wednesday and Friday, two reviews one month later and at the beginning of each year the 80 most difficult words of the preceding grade are reviewed. Other details cannot be given. The method in a general way is an illustration of certain present-day principles of psychology which considers learning to be rather specific in character. A. I. G.

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10. *The development of a new economic and social curriculum in our secondary schools.* It is difficult—yes, almost impossible—for a teacher of social science to find adequate printed material to put in the hands of high school pupils. For years, we have recognized that new material would be introduced into our "social-studies" curriculum only through new types of text books. New books come from the press constantly. In the main they are formal and contain "structural" (as opposed to functional) discussions of government, administrative history, and formal economics. Two books have appeared recently,[10] two published within the month which typify the different movements in this field.

Our Economic Organization by Professors Marshall and Lyon may well be regarded as an epoch-marking book. It represents a completely new type of economics and attempts to do for the high

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[10]Marshall, L. C., and Lyon, L. S. *Our Economic Organization.* New York: MacMillan Company., 1921. Pp. X + 503.
Ames, E. W., and Eldred, A. *Community Civics.* New York: MacMillan Company, 1921. Pp. XIV + 387.

school what is being done in various books of "readings" of industrial society by such men as Professors Marshall, Hamilton, and the like. This new book aims to give pupils a clear notion of the working of economic laws and of the building and carrying on of industrial society, by means of concrete descriptions and interpretations of the way in which we live and work in an industrial society. It is a radical departure from the common run of "economics" text-books, in its emphasis upon the use and work of industry—banks, business organizations, government, scientific management, and the like. The authors have broken away from tradition in many places; for example, in the complete omission of discussions of "value" and "distribution."

Not only is the book an improvement from the standpoint of the selection of material, but also from the psychological viewpoint of arrangement. Historical backgrounds are given by a series of fairly detailed and sharp contrasts. This is one of the exemplifications of the theory of presenting historical development which the present reviewer is developing and hopes to see carried out in the organization of our historical courses. Furtherfore, the writers have broken away from the encyclopedic, paragraphic treatment to which nearly all school text books are committed. At the beginning of each "study" ("studies" replace "chapters") the exact purpose of the work is stated definitely. The authors likewise present long lists of problems, questions, activities, for teachers to use with their pupils. We believe that learning could be more enhanced if the material of the book had been *organized around* problems and questions. We doubt if public school teachers are equipped to make the most effective use of lists of problems, questions, and activities, which are appended to chapter discussions.

The newest addition to the list of community civics books is one by Ames and Eldred. This is a curious mixture of concreteness in presentation of certain problems such as, the beginning of a community; home, family, and the community; and a formal, abstract, definitional treatment of many other community activities. For example, in the chapter on migration, the detailed, and interesting "story of Pietro" is to be contrasted with the brief paragraphs on the "causes" and "results of immigration." The book is a collection of textlike chapters on different community activities. The present reviewer is utterly unable to find any continuity of organization or

sequential thread running through the presentation. Several chapters appear on education, public health, protection of life and property, work and play, correction, migration, the needy and dependent, government and making a living, the lawmakers of state and nation and the like. H. O. R.

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11. *A concrete methods book for Junior-High School English.* The supervised study movement is being kept alive by such devices as new textbooks in the supervision of study in the various school subjects. MacMillan is issuing a series of books under such captions as: *Supervised Study,* Miss Simpson's *Supervised Study in History,* and *Supervised Study in English,* all under the editorship of Professor A. L. Hall-Quest. His book, *Supervised Study,* was published several years ago. A number of public school teachers, notably in Rochester, New York, have been preparing books of technic on the teaching of the separate subjects, following closely the principles laid down by the editor.

This is well illustrated by Miss McGregor's[11] application in the field of English. The book gives lesson plans. It is full of suggestions for teaching technic from the experience of a good teacher; it suggests new materials, and presents digests of helpful devices for teaching the subject; *e. g.* "corrective substitutes," discussions of the correct use of verb forms, and the like. In each case the writer tells what was done by the teacher under her supervision. Thus, the book is an empirical description of what has apparently worked in one school system. As a book of suggestions on methodology, it should be helpful.

The present reviewer believes that it is possible to improve the teaching of the school subjects more directly than by recommending to teachers that the hours of a school program be divided up into different periods in which different tasks are assigned to different periods. This is a recommendation of these supervised study workers. For example, the Supervised Study advocates recommend (as is illustrated by Professor Hall-Quest and his co-workers) that each class exercise should be sub-divided and definite provision made for different kinds of work. For example for a lesson in oral com-

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[11]McGregor, L. A. *Supervised Study in English.* New York: MacMillan Company, 1921. Pp. XII + 220.

position in the 7th grade, covering 50 minutes, it is recommended that "review" receive 9 minutes, "assignment" 10 minutes, "silent study" 6 minutes, "oral expression" 20 minutes, and "summary" 5 minutes. The application to literature, to written composition, and to grammar is made with distinctly different recommendations as to division of time. An experiment which the reviewer is now carrying on in fifth grade social studies raises questions about the validity of this procedure and suggests that to assign periods of different kinds of work within the class hour may quite completely formalize the lesson. H. O. R.

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12. *A Significant Conference Report on Sex Education.* The booklet[12] referred to is a preliminary edition of the findings of a series of conferences on sex education held under the auspices of the International Committee of Young Men's Christian Association. The work was done under the active direction of Dr. Thomas W. Galloway. The method of the conference is indicative of the trustworthiness of a report in which dogmatism, prejudice, and unsupported personal opinion give way to the unbiased group judgment of a large number of conferees whose special interests and abilities fit them to contribute from widely separated viewpoints to a subject of general concern. The reader is impressed by the potential significance of the co-operation of general educators, teachers, biologists, psychologists, psycho-analysts, sociologists, physicians, and physical directors, and feels it incumbent upon himself to assume a similarly impersonal attitude in evaluating the report.

Because so many people still question whether anything can or ought to be attempted in sex education, and others over-emphasize partial and emergency objectives, ignoring other equally important aims, the issue is carefully defined. "It is quite obvious that sex qualities and relations profoundly influence conduct, development, and relations which are not sexual; and that non-sexual phenomena equally influence the sexual attitudes and conduct. Hence this statement of imbedding sex education and its motives and purposes in the whole purpose of education and life was the most conspicuous point of agreement in the conference, in its effort to outline objectives. Sex education is not in its nature a special form

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[12]The American Social Hygiene Association. *Preliminary Synthesis and Integration of the Returns of the Sex Education Conference.* New York, 1920. Pp. 95.

of education; it is merely character education which ceases to ignore one of the most imperious and pervasive groups of incentives in human nature."

The proposed integration takes account of individual differences but recognizes the significance of a psychological gradation of the proposed training and motivation.

The special report of the General Education Section of the conference shows general agreement on the following point among many others: "Anything which segregates sex education arouses undue consciousness and more or less apprehension, which interferes with the best emotional results."

The report deals rather exclusively with the problems relating to boys and young men. Revision and restatement with reference to the needs of girls and young women is contemplated. L. Z.

III. ADDITIONAL PUBLICATIONS RECEIVED.*

A. Mental and Educational Tests.

Roback, A. A. *Roback Mentality Tests for Superior Adults.* Boston: A. A. Roback, Simmons College. 1920.

B. Publications in the General Educational Field.

Coursalt, J. H. *The Principles of Education.* Boston: Silver, Burdett & Co. 1920. Pp. XII + 468.

Hosic, James F. *Sample Projects.* First Series. 506 W. 59th street, Chicago. 1920. Pp. 32.

Kelly, R. W. *Training Industrial Workers.* New York: Ronald Press Co. 1920. Pp. XXI + 437.

Patrick, G. T. W. *The Psychology of Social Reconstruction.* Boston: Houghton-Mifflin Company. 1920. Pp. IX + 273. $2.

Snedden, D. *Sociological Determination of Objectives in Education.* Philadelphia: J. B. Lippincott & Co. 1921. Pp. 322. $2.50.

Strayer and Engelhardt. *The Classroom Teacher.* New York: American Book Co. 1920. Pp. 400.

Turner, E. A. *The Essentials of Good Teaching.* New York: D. C. Heath & Co. 1920. Pp. XIII + 271.

C. New School Textbooks.

Beard and Bagley. *A First Book in American History.* New York: MacMillan Company. 1920. Pp. IX + 460.

Lindquist, T. *Junior High School Mathematics.* Book I. New York: Scribner. 1920. Pp. VI + 235. $1.12. Book II. Pp. VII + 237. $1.24. Book III. Pp. VII + 243. $1.36.

D. Publications of United States Bureau of Education.

A Survey of Education in Hawaii. Bureau of Education. Bulletin No. 16. 1920. Pp. V + 408.

E. Miscellaneous Publications.

California: *Report of the Special Legislative Committee on Education.* Sacramento: California State Printing Office. 1920. Pp. 96.

Coffman, L. W. *Teacher Training Departments in Minnesota High Schools.* New York: General Education Board. 1920. Pp. VII + 92.

General Education Board: *Annual Report* 1919-1920. New York. Pp. VII + 141.

Goodspeed, Helen C. *Suggestions for Teaching Homemaking in the Grades and High School.* Wisconsin: C. P. Gary, State Superintendent. 1920. Pp. 39.

Hall, A. B. *Dynamic Americanism.* Indianapolis: The Bobbs-Merrill Company. 1920. Pp. 325.

Rich, Frank M. *School Economies.* Baltimore: Warwick & York. 1920. Pp. 72.

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*Publications which are reviewed in this issue are not listed here.

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